GRA 19502

Master Thesis

The Scandinavian Stand-Off: A Comparison of the Norwegian and Swedish Government Pension Funds' Investment Performance and Management

Navn:	Hanne Helene Heiestad, Marta Vattøy Kristensen

Master Thesis

Study Program: MSc in Finance

Prepared by: Hanne Helene Heiestad & Marta Vattøy Kristensen

Supervisor: Bruno Gerard

Date of submission: 21.08.2018

This thesis is a part of the MSc program at BI Norwegian Business School. The school takes no responsibility for the methods used, results found and conclusions drawn.

Acknowledgements

We would like to express our most sincere gratitude to our supervisor, Professor Bruno Gerard, for his interest and expertise on the subject, and for his support and continuous guidance throughout our thesis and related research. We are thankful for his insightful comments and encouragements, but also for asking hard questions which made us widen the research from different perspectives.

Table of Contents

Abstract

This thesis examines the similarities and differences between the Swedish and the Norwegian National Pension Funds, the Swedish National Pension Funds (AP) and the Government Pension Fund Global (GPFG), respectively. We have compared the funds along two dimensions: institutional structure and investment management on one side and investment performance on the other. Ultimately, this thesis examines whether the different underlying purposes of the funds, which affect the investment management, can explain differences in performance. Additionally, we have linked the funds' investment management to the Endowment model and the OECD best practices for pension funds. We find that the differences in institutional structure and management has led to differences in investment performance. Overall, we find that GPFG is the most cost-efficient and achieves the best risk-return relationship, while the AP funds seem to have a superior long-term investment strategy.

1. Introduction

Norway and Sweden are two very similar countries with respect to government structure, social values, and the fact that they are both successful welfare states. Despite the similarities they have chosen to structure their pension systems and their pension funds differently. Both the Government Pension Fund Global (GPFG) and the AP funds are state-owned funds, but were established to serve different purposes.

The AP and the GPFG have grown to become large and have a significant impact on the market. At the end of 2016 the GPFG had a total asset of $893,088 mill under management, while the four AP funds had $141,145 mill combined (Willis Tower Watson, 2017). The GPFG is defined as a sovereign wealth fund, while the AP funds are classified as sovereign pension reserve funds, because they were established to serve different purposes. As a pension reserve fund, the AP funds' main purpose is to cover pension liabilities, while the GPFG as a sovereign wealth fund has no formal pension obligations. Both the GPFG and the AP funds are to achieve the highest possible returns with the lowest possible risk within an applicable framework.

We investigate the differences and similarities between the two systems along two dimensions: institutional structure and investment management on one side, and investment performance on the other. We first compare the Norwegian and the Swedish funds in terms of how the two countries legislation defines their mandates, and how the mandates in turn defines the funds' management, structure, asset allocation, and risk. The second part of our thesis is a quantitative part, which focuses on comparing the returns, risks and costs of the two funds, and using a standard valuation and calculation methodology for both funds, which allows us to compare their performance.

Comparing the investment performance of the funds is interesting in itself. However, further interesting insights can be gained by linking the performance to the institutional framework in which the funds operate. The restrictions imposed in the investment management part in terms of the legislation and mandates constraints the funds' investment approaches and strategies. These constraints

may affect the funds' investment performance. Ultimately, this thesis examines if the different underlying purposes of the funds, which affect the investment management, can explain the differences in performance.

The research question we wish to examine is:

"Do differences in the underlying purposes and institutional structure of the Norwegian and Swedish National Pension Funds lead to differences in performance outcomes?"

Institutional investors have become major players in national and international financial markets, and it is therefore interesting to compare and see how two large players such as the GPFG and the AP funds have chosen to navigate in that landscape. Comparing the funds will also give interesting insight into how funds interpret and incorporate their mandates into their investment strategies, and how this may lead to differences in performance. It is also interesting to see how funds, who have a responsibility to secure the long- term welfare of its beneficiaries, remain sustainable. To our knowledge there are no previous studies comparing the GPFG and the AP funds in terms of both investment management and returns.

In section 2 we will present the background and literature relating to the topic. Section 3 consists of a description of the Endowment Model, the OECD best practices, as well as the liability structure of a pension plan. Further on, in section 4 we describe the mandates of the funds, and the funds' developments where we link them to the Endowment model and the OECD best practices. In section 5 we present the investment performance part where we describe and compare returns, risk, and costs. A discussion where we link management to performance will be presented in section 6. Lastly, in section 7 we present our conclusion.

2. Background and Literature Review

2.1 Background

"Pension funds are one of the most important players in the financial markets of the OECD countries" (OECD, 2006). These funds manage large amounts of assets on a worldwide basis and therefore has a large impact on the world economy. The

GPFG and the AP funds have grown to become two important players, although they have vastly different fund structures.

The main difference between the funds, besides their structure, is that they were established with slightly different purposes. The Swedish AP funds exist exclusively to generate old-age pension payouts, while the Norwegian GPFG funds other social obligations. Hence, the GPFG is classified as a Sovereign Wealth Fund (SWF). SWFs usually have objectives to diversify and improve reserves or commodity such as oil revenues, and shield the domestic economy from fluctuations in commodity prices, resulting in investing in mostly foreign assets (Blundell-Wignall et al, 2008). The GPFG, despite its name, has no formal pension liabilities (NBIM, 2016a). The AP funds are classified as Sovereign Pension Reserve Funds (SPRF), which is a type of Public Pension Reserve Fund (PPRF) that is owned and established directly by the government, and its financial inflows are mainly from direct fiscal transfers from the government (Blundell-Wignall et al, 2008).

Sovereign Wealth Funds (SWF) and Public Pension Reserve Funds (PPRF) share many similarities such as being large in terms of assets under management, have long-term investment horizons, and are accountable only to governments or public-sector institutions, as representatives of the owners or beneficiaries. They are both also investing increasingly abroad and moving into more alternative assets such as real estate, private equity and hedge funds. Their similarities give rise to the same concerns such as financial stability, corporate governance and political interference and protectionism. Despite the similarities, Blundell-Wignall, Hu and Ilmanen (2008) identified that SWFs and PPRFs tend to differ with respect to their objectives, investment strategies, funding sources, and their requirements to transparency.

Both AP and GPFG are owned by the government on behalf of the Swedish and Norwegian people. Neither country's population have self-selected into the funds. This, in addition to being providers of welfare, increases the need to act and invest responsibly, and the need to be transparent. NBIM (2018a) states that it is "dependent on confidence to achieve our mission", and that it therefore "aims to be a professional, transparent, and responsible investment manager". Most of the

information, such as annual reports, is available to the public, except for market sensitive information.

2.2 Literature Review

This section will briefly describe the existing literature on the two funds' background, mechanisms and investment approaches, benchmarks with which we can conduct a comparative study, guidelines for "best practices" of pension funds, and typical differences and similarities of such funds, and how these impact the factors we will study.

Ang (2010) discusses guidelines a country should take into account when establishing SWF and in the role SWFs have in the government's overall policy in an economic and political context. The paper reviews four main benchmarks which allows SWFs to compare their activities, including financial performance and optimal asset allocation policies, management structure, and the long-run equilibrium of markets. The first benchmark of legitimacy secures the capital managed by the SWF by ensuring that it is gradually dispersed between the present and future generations, instead of being immediately consumed. The second benchmark of integrated policy considers the implicit liabilities of SWF's by taking into account its role in government fiscal policies. The third benchmark of governance structure and performance are concerned with that different governance structures require different financial benchmarks to reach their mandate. The final benchmark of long-run equilibrium requires SWF with long-term horizons to consider the markets in which they invest and the external factors affecting the SWF in the long-term.

Blundell-Wignall, Hu and Ilmanen (2008) analyzed similarities and differences between Sovereign Wealth Funds (SWF) and Public Pension Reserve Funds (PPRF), where SWFs are pools of assets owned and managed by governments to achieve national objectives, while PPRFs are pools of capital to finance the public pension system. The two types of funds have similar concerns, particularly about financial stability, corporate governance and political interference and protectionism. SWFs and PPRFs mainly differs in four dimensions; objectives, investment strategies, sources of funding, and transparency requirements. They also found that a concern of SWFs is how the strategic and political objectives

impact exchange rates and asset prices, but they also found that SWFs also provide mechanisms for breaking up concentration of portfolios that otherwise increase risk. They conclude that enhancing governance and transparency of SWFs are important, but needs to be weighed against commercial objectives.

Chambers, Dimson and Ilmanen (2012) presented and evaluated strategies followed by the Norwegian Pension Fund, review of long-term performance and described how the fund responded to the financial crisis. They present how the fund's long horizon and low spending needs have equipped it exceptionally well to bear short-term drawdowns, and also has enhanced Norway's reputation as an investor. They further explain how the fund has relied almost exclusively on publicly traded securities constrained to a low tracking error, has had rigorous asset allocation that allows little deviation from the policy portfolio, and how it depends mostly on beta returns, not alpha returns. The paper found that the Norwegian fund reduces risk through diversification, focuses on cost efficiency, embraces elements of active management, is committed to transparency and openness, and has a clear governance structure designed to deliver a well-considered strategy.

The OECD (2006) has formalized a set of guidelines on pension fund asset management, which is a basic framework for the regulation of pension fund investment, and they address regulatory concerns that arise in the asset management of pension funds. These guidelines are non-binding but aim to present good practices and guide policymakers, regulators, supervisors, and other entities involved in pension fund administration and management. The guidelines suggest that the governing body of the fund should be subject to a "prudent person standard" such that the investment of pension assets is done with care, skill, prudence and due diligence. The guidelines also suggest that the investment policy should start with the basic premise that the regulatory framework should take into account the income objective of the pension funds and contain pension law, related trust law, tax requirements, standard set by pension and codes of conducts. They further suggest to include the implications of different types of portfolio limits, such as accounting for the fact that simultaneous decreases in the value of one asset category and increases in the value of another may have

substantial implications on portfolio allocations. They also state that valuation methodology of pension assets should be consistent and properly disclosed.

3. Theory

3.1 The Endowment Model

The Endowment Model is an investment philosophy conventionalized by David Swensen, who is the chief investment officer at the Yale Endowment Office. It has gained popularity, largely due to the success of the Yale endowment which grew from $1 Billion in 1985 to $23.9 billion in 2014 (Ferri, 2012).

The model suggests that investors such as endowments and pension funds can generate great returns by moving a large portion of their investment away from the traditional portfolio allocations and into more alternative assets in accordance with modern portfolio theory, such as hedge funds, private equity, real estate and others (Curtis, 2012).

The Endowment Model has a strong equity orientation, since only around 4% of the portfolio is invested in bonds. The approach recognizes that the way long-term investment horizons of endowments allow them to trade liquidity for returns, which suggests large allocations to less liquid shares. Including hedge, private equity and real assets, roughly 82% of Yale´s portfolio is illiquid. The model believes that more illiquid assets will generate higher returns, and that the risk that comes with the illiquidity is less prominent due to the long investment horizon through diversification (Curtis, 2012).

The model also believes in active management, as Yale has almost no index-like investments. The active management can largely be attributed to a wide use of external managers, and the strategy is based on a commitment of active management of portfolio diversification which underpins the success of the model (Akintona, 2017).

3.2 OECD Best Practices (2006)

The OECD have created a set of guidelines for pension funds asset management. The guidelines are recommendations for the basic regulatory framework of

pension fund investment and they address regulatory concerns that arise in the asset management of pension funds.

In terms of investment policy, the guidelines for best practices recommend that there should be clear objectives that have to be consistent with the retirement income of the pension funds. The objectives therefore have to include acceptable degrees of risk, identify a strategic asset allocation, and have clear criteria for how the governing bodies assess effectiveness and changes and implementation of policies.

The best practices also include guidelines on portfolio limits, such as a maximum level of investment by asset classes, but no minimum limit. Furthermore, there should be no excessive risk exposure above the level of risk required to generate the returns needed. The limits set for the portfolio need to be regularly assessed particularly in the use of external asset managers to implement optimal investment strategies.

The best practices also recommend having a proper, transparent and disclosed basis for valuing the assets managed by the pension fund, and that the valuation methodology should rely on market value or fair valuation methodology, and be consistent.

3.3 Defined Benefit vs. Defined Contribution

"The liability structure is the starting point for the investment strategy of a pension plan" (Blommestein and Funke, 1998 p. 22). The liability structure of a defined contribution (DC) plan differs significantly from that of a defined benefit (DB) plan.

Defined Benefit (DB): A Defined Benefit plan is a plan where the sponsor agrees to make specified payments to members at retirement. "A defined benefit plan is any pension plan other than a defined contribution plan, including all plans in which the financial or longevity risk are borne by the plan sponsor" (Tapia, 2008 p. 5). Thus, the plan sponsors assume the risk of having insufficient funds (Blommestein and Funke, 1998). The pension obligations are effectively the

sponsors of debt obligations, which implies that the sponsor needs large reserves to cover its liabilities (Folpmers, 2012).

Defined Contribution (DC): Under a DC system, in contrast to under DB, the sponsor is only responsible for making specific contributions into the plan on behalf of the participant (Ponds et al, 2011). In order for the participants to receive a certain amount of money at a future point, the participants in a DC system are required to pay a contribution today (Blommestein and Funke, 1998). Despite of the paid contribution being specified, the participants do not know what the amount of the payout benefits will be until the time of retirement. This means that the amount of payout depends on the realized investment results, not only the paid contribution (BIS, 2012). Under the DC system the participant bears all risks, both financial and longevity risk.

Norway has a final pay DB scheme, while Sweden has a hybrid scheme that is a combination of DC and DB (Ponds et al, 2011). Thus, the liability structures of the pension plans in the two countries differ, which in turn can affect the investment strategies.

4. The Investment Management Part

4.1 Mandates

The GPFG and the AP funds are owned by the government on behalf of the Norwegian and Swedish people, respectively. The day-to-day operational management of the funds are administered by Norges Bank Investment Management and The Swedish National Pension. The funds' governing bodies issue mandates the investment managers must follow, to ensure that the fund is managed in the best interest of the ultimate owners and with a long-term perspective. The mandates specify which markets to invest in, the allocation of assets in different asset classes, and the risk the fund is allowed to bear.

4.1.1   The GPFG

"The Norwegian Government Pension Fund - Global (GPFG) was created to serve as a long-term savings vehicle that would secure income from oil revenues as a

non-renewable resource for future generations by diversifying into a broad portfolio of international securities" (Chambers et al, 2012). The NBIM's overall mandate for the fund is that they "shall seek to achieve the highest possible return after costs measured in the investment portfolios currency basket and within the applicable management framework." (NBIM, 2017e).

The GPFG receives oil-revenues and government profits to invest for future generations, and the Norwegian state is allowed, through *Handlingsregelen*, to spend up to 4%, 3% from February 2017, of the fund's wealth annually in the state budget. Thus, the GPFG has no formal pension liabilities, but is expected to contribute to the stability of the Norwegian welfare state each year.

4.1.2   The AP Funds

AP1 through AP4 are classified as a sovereign pension reserve funds, and they manage parts of the buffer capital of the income pension system. Their "role is to equalize the fluctuations in the balance between pension contributions and pension payments" (Aktiespararna, 2010). If the pension contributions do not cover the pension payments the funds need to cover the shortfall, and thus suffer an outflow. The four funds have one overarching mandate which states that the funds should "manage fund assets in such a manner so as to achieve the greatest possible return on the income-based retirement pension insurance. The total risk level of the investments made by the Funds must be low" (Riksdagen, 2014). Each of the four AP funds are free to interpret this mandate independently, which can lead to four different investment objectives. These investment objectives are further restricted by Swedish law. From the National Pension Insurance Fund Act, the investment restrictions in 2017 states among others that investment decisions may not be influenced by government policies, that at least 10% of assets must be managed externally and no more than 40% of assets may be exposed to foreign exchange risk (see exhibit 2 in Appendix A).

4.2 Development of the Funds

4.2.1 The GPFG

The Ministry of Finance in Norway is responsible for managing the Government Pension Fund of Norway, but it is Norges Bank that has been delegated the operational management, in accordance with guidelines and frameworks set by the Ministry of Finance. Norges Bank established a fully owned subsidiary called "Norges Bank Investment Management" (NBIM) as the entity that is actually managing the fund on an operational basis, while the board of Norges Bank has the role as the board of the fund (Chambers et al, 2012). The fund is made up by two separate investment funds that also have separate mandates; the Government Pension Fund Global (GPFG) and the Government Pension Fund Norway (GPFN). This study will only focus on the GPFG because its assets are invested outside of Norway, while the GPFN invest only in Norway (Ang et al, 2009).

The Government Pension Fund Global (GPFG) was initially founded to preserve the oil revenues for future generations. The Government Pension Fund Global was officially established in 1990 to invest the surplus revenues of the Norwegian petroleum sector where the first transfer to the fund was in 1996. Up until 1998, the fund only invested in government bonds, but in 1998 the Ministry of finance decided to invest maximum 40 percent of the fund in equities and the remaining 60 percent in fixed-income assets (Chambers et al, 2012).

The fund's investment strategy leaned toward a traditional portfolio allocation with passive indexing at this point, but during the early 2000's the fund added five emerging markets to the fund's benchmark equity index, and corporate and securitized bonds were added to the fund's benchmark fixed income index, so the investment strategy switched to more enhanced indexing (Vittas and O´Connor, 2008).

In 2007, the ministry of finance decided to increase the fund's share of equity investments from 40 to 60 percent. It also decides to add small-cap companies to the benchmark portfolio. In 2008, the Ministry of Finance included a maximum share of 5 percent of total assets in (non-listed) real estate investments in the fund's investment specter (NBIM, 2017c). By adding the real estate portion into their investment portfolio, the fund was allowed enhanced protection against

inflation risk (Chambers et al, 2012). This was mostly due to the creation of a more diversified investment portfolio, which the Endowment model was an advocate for and had gained superior profits by implementing more diverse investments (Curtis, 2012).

In 2010, its mandate was modified to specify a maximum 5 percent holding in real estate only though a corresponding reduction in fixed-income holdings (NBIM, 2017a). The OECD Best Practices (2006) recommend only setting maximum levels of investment by category, and not prescribing minimum levels, which GPFG is in accordance with. The fund still held a share of equity investments up to 60 percent and up to 40 percent in fixed-income securities, which compared to the Endowment model still was seen as more conservative and passive (Curtis, 2012).

In 2012, the Ministry of Finance announces plans to gradually reduce the share of European holdings to about 40 percent of the fund and increase investments in emerging markets to 10 percent. In accordance with the Endowment model they now invest in more illiquid assets with higher risk, but these investments also offer the fund more diversification (Curtis, 2012).

In 2017, the mandates restrictions on real estate was modified to allow the unlisted real estate portfolio to constitute up to 7 percent of the investment portfolio (NBIM, 2017a). As of September 2017 the fund's asset allocation was 65.9 percent equities, 31.6 percent fixed income and 2.5 percent unlisted real estate. In early 2018, the mandate was amended again to increase the equity allocation to 70%. The fund has during its life moved towards a less conservative asset allocation with more alternative investments and investments in illiquid assets, but compared to the Endowment model they still maintain a larger amount of their holdings in fixed-income and liquid assets.

4.2.2   The AP Funds

The AP funds are managed by the state. Each of the funds have their own separate board of directors who is fully responsible for the fund's operations and are appointed by the Government of Sweden. The funds have similarities to limited companies, as the board of directors delegate tasks for operating activities to a

CEO. Each of the different funds are annually reviewed by the Ministry of Finance who present the review to the Parliament, but the government has waived its regulatory oversight, so that the operations of the funds is almost exclusively prescribed by laws (AP3, 2016), and the supervision provided by the board.

In effect, this means that the Swedish Parliament has no real direct oversight other than the "National Pension Insurance Fund Act", which are laws and guidelines that all the funds are required to comply with, but this act also gives the board of directors full and collective responsibility for the funds' administration within the parameters set by the Parliament. Even though the Government has waived their regulatory oversight, the Swedish Government still conducts annual evaluations of the funds and submit this to the parliament together with the annual reports. The government also appoints all the members of the board of directors, alongside appointing two auditors to each AP fund (Yermo, 2008). The board of director's responsibilities and activities are not prescribed by statute, but are set out in the "Board's Work Plan" which is approved annually.

As for most other pension funds who have broad mandates, it is typical for such funds to have a governing body that must further interpret the board over-arching mandate in order to set more specific long-term investment objectives, guidance and benchmarks. However, as the Swedish Government has waived the regulatory oversight, this task is done independently by each of the funds, which in practice has translated into four very distinct long-term objectives, subject to limited but strict legal investment restrictions (Severinson and Stewart, 2012). Due to the mixed public and private structure of the AP funds, they are subject to a variety of internal and external rules and frameworks, such as the National Insurance Fund Act, Policy on Governance and Evaluation of AP funds, Accounting and Valuation Policies, Public Procurement Act and the Swedish Code of Corporate governance (AP3, 2015).

When the APT-system came into effect in the 1960's, the national pension fund were split into three funds in order to secure long-term savings. These three funds permitted investments only in fixed-income securities, and asset management for the three funds were coordinated in a single organization (AP1, 2012).

In 1974 the fourth fund was established and only permitted to invest in equities, and in 1988 the fifth fund was created and also only permitted to invest in equities. As the two new funds arose, the three first funds were given less restrictive investment rules, being permitted to investing in equity and real estate. In 1996, the sixth fund was created which invested in equities, riskier markets and focused on small to medium sized companies, and was responsible for the funds from wage-earners (AP2, 2016a). The funds thus started to move away from the traditional portfolio management strategies and take into account more diverse and alternative investment methods as in accordance with the Endowment model (Curtis, 2012).

In the early 90's a broad review of the Swedish pension system warned that APT-system was not financial stable and there was a risk that the current AP funds could be drained in the beginning of the 2000's (AP4, 2014). So in late 1990's the Swedish Parliament decided to reform the national pension system into a five-party agreement. The first through fourth fund, as well as the sixth fund became buffer funds which in the long-term would manage pension capital according to identical investment rules, thus providing the opportunity to invest in diversified asset classes. They act independently and have separate management plans, investment and ownership policies (AP4, 2014).

The main reasons for the multiple fund structure was to reduce market impact, to diversify management risks, allow competition to reduce costs and improve performance and reduce political interference. The objective of allowing the funds to have independently set goals and decide on asset allocation was to diversify strategic risks (Severinson and Stewart, 2012). However, the lack of coordinated and targeted investment objectives and long-term performance benchmarks for all of the AP funds have resulted in that the funds mainly just benchmarking their performance against each other, which is not recommended by the OECD best practices as this do not show the full picture of the performance of the funds on a larger level (OECD, 2006).

The AP funds are obligated by law to comply with a limited set of allocation restrictions (See exhibit 2 in appendix A). Among these, they have to invest at least 30 percent of their assets in fixed income securities, face no more than 40

percent currency risk exposure of the assets, and cannot hold more than 10 percent of the voting rights in a single companies. No more than 5 percent of asset can be invested in unlisted securities, and external managers should manage at least 10 percent of assets (AP2, 2017). Beyond these, the funds have chosen to interpret their broad mandate as they see fit. The floors on the fixed-income securities is not in accordance with the OECD best practices (2006) as it is only recommended to have ceilings on investment limits.

4.3 Investment Management Approaches

This section will discuss in-debt the actual investment approaches used in practice by the GPFG and the AP funds. As we have gone through the broad overarching mandates of the fund, it is useful to examine the extended ownership through their investment management in practice.

4.3.1 The GPFG

NBIM's investment strategy has continuously changed over time, with help provided by the Ministry of Finance through recommendations from external experts. In earlier years, NBIM's management of the GPFG was organized by asset classes of equities and fixed income where their mandates were awarded to both internal and external managers. In more recent years the management of the fund has tried to take advantage of the fund's characteristics such as its large size and long-term horizon more systematically across the traditional asset classes. This is why the fund today is organized by strategy rather than asset class. The strategies are grouped into three broad categories: asset mix ("fund allocation"), investments in individual companies ("security selection") and market exposure ("asset management"). These strategies complement each other by having different time horizons, being based on different frameworks and are expected to produce excess returns under different market conditions, such as changes in liquidity, risk and various cyclical patterns. Furthermore, they have developed more in-house expertise and capacity to manage strategies internally that were originally outsources to external managers (NBIM, 2018c).

Looking to see whether NBIM is leaning more towards a passive strategy, which would be to mimic a benchmark index by following set rules, the GPFG states

that such a strategy would not be compatible with their current requirements and expectations when it comes to responsible investments, investments in real estate, investments in emerging markets, factor exposures or risk management. Thus, such a strategy would therefore require a different management mandate then the one they are currently following, as it would also be difficult to match the benchmark portfolio's return (NBIM, 2017f).

In conclusion, NBIM's management of the GPFG are subject to legal requirements alongside management mandate restrictions. Within this framework, they have an index-oriented strategy where they attempt to match their benchmark index, while also adjusting for exposure to different factors, in addition to managing actively their real estate and some other assets. They do almost all of their management internally with few external managers.

4.3.2   The AP Funds

The AP funds have been viewed as early pioneers of factor investments, to develop more exact and balanced portfolios. The AP funds implemented a factor approach in parallel with a traditional asset-based approach for a long time (Rundell, 2017). However, the AP funds have since their inception been subject to strict and specific investment restrictions, leaving the funds' with less room to adopt varying investment strategies which can take away some of the potential benefits of competition and diversification from having four different funds. These investments rules are common for all the funds, and the investment directives for the AP funds can be found in exhibit 2 (see appendix A).

The AP funds utilize a two-dimensional analysis, strategic and quantitative, to achieve their investment targets. In their strategic analysis, they use an Asset Liability Management (ALM) portfolio combined with a strategic portfolio to find the optimal portfolio for a given level of risk. The strategic portfolio is the funds' reference portfolio. Through the quantitative analysis they determine the funds' actual portfolio. The funds believe that they can increase the probability of achieving active returns through active management by combining the investment decisions with different time horizons, which in turn will yield high risk-adjusted returns. The boards of the funds decide how much the ALM portfolio can deviate

from the strategic portfolio, and the active management of the funds is to uphold the strategic portfolio and increase returns (Blomstergren and Lindgren, 2008).

Parts of the AP funds' actual portfolio is managed by external managers. The external management has shifted from a multi-manager approach targeting diversification and generation of excess returns, to fewer managers with either basic or specialist mandates (AP1, 2010). The trend among all the funds has been a shift towards more in-house asset management, but their investment rules states that a minimum of 10% should be managed externally (Moss, 2017).

Over the years the AP funds have focused increasingly on alternative investments, which consists predominantly of unlisted assets with low liquidity, such as real estates, private equity, hedge funds and opportunity investments (AP1, 2010). The AP funds have been seeking to overcome the strict restrictions upon illiquid investments. The funds have been subject to an effective cap on alternative investments as they need at least 30% in liquid fixed income, which restricts their alternative investments if equity exposure is not reduces. There is also a 5% cap on private equity exposure for the funds (Moss, 2017).

To conclude, the AP funds have more active in-house management, as their approach is not so much concerned with indexing, but rather finding liquid or non-public illiquid investments that has the highest return without affecting the level of risk. They are leaning towards a strategy which will make the factor investments more broad and efficient, and will lead the funds to apply leverage in the form of derivatives backed by liquid assets, to increase factor exposure in multi-asset trends and momentum strategies (Rundell, 2017).

4.4 Actual Investment Allocations

After looking at how the funds manage their investments, it is also useful to examine the funds' actual asset allocation over the relevant time period. The table below will provide an overview of the actual asset allocation of all the funds at the end of four different time periods. We look at the initial strategy (2002), before the financial crisis (2007), after the financial crisis (2010) and the current strategy (2017). As previously mentioned, the funds have incoherently reported their asset allocation in the annual reports throughout the years. Consequently, we have reported the asset allocation available to us in those reports, despite the inconsistent nature of the reporting. Ideally, we would have preferred to categorize equity as domestic and foreign, and further categorize the foreign equity as either emerging or developed. Similarly, fixed income would ideally be divided into domestic and foreign, where the foreign fixed income would be further divided into government or corporate. Furthermore, the funds do not always separate real estate from alternative investments, so where possible we have reported both categories.

Table 1: Overview of Actual Asset Allocation

This table contains the actual asset allocation of the funds during four different years; the beginning of the time period, before the financial crisis, after the financial crisis and the current asset allocation as of 2017. The different asset classes are equity, Swedish equity (Swedish), foreign equity (foreign), emerging equity (emerge), developed equity (develop), fixed income (fixed), Swedish fixed income (Swedish), foreign fixed income (foreign), corporate fixed income (corp), government fixed income (gov), index-linked bonds (index), inflation-linked bonds (inf), alternative investments (alt.inv), real estate (real) and portion of external managers (external).

YEAR	GPFG	AP1	AP2	AP3	AP4
2002	**Equity: 38.5%** Emerge: 2.6% **Fixed: 61.5%** **External: 20%**	**Equity: 56.2%** Foreign: 45.6% Swedish: 11% **Fixed: 40.1%** Foreign: 21.3% Swedish: 10.4% Index.: 8.5% **Real: 3%** **External: 31%**	**Equity: 49%** Foreign: 39% Emerging: 2.1% Swedish: 20% **Fixed: 38%** Swedish: 16% Gov: 12% Corp: 4% **Real: 3%** **External: 38%**	**Equity: 56.3%** Swedish: 16.2% Foreign: 40.1% **Fixed: 36.9%** Swedish: 12.6% Index: 8.1% Foreign: 16.2% **Real: 6.8%** **External: 28.4%**	**Equity: 61.8%** Swedish: 24.2% Foreign: 39% **Fixed: 33%** Gov: 43% Corp: 57% **Real est.: 2.9%** **External: 13.5%**
2007	**Equity: 47.4%** **Fixed: 52.5%** **External: 20%**	**Equity: 57.5%** Swedish: 12.7% Foreign: 38.8% Emerging: 6.2% **Fixed: 38.7%** Swedish: 8.7% Foreign: 20.4% Index: 9.6% **Alt.inv.: 3%** **External: 36%**	**Equity: 59.7%** Swedish: 19.8% Foreign: 39.4% **Fixed: 35.4%** **Alt.inv.: 5.4%** **External: 24%**	**Equity: 52.5%** Swedish: 10.7% Foreign: 41.6% **Fixed: 40.7%** Swedish: 9.3% Foreign: 31.3% **Real: 2.8%** **External: 39.9%**	**Equity: 59.9%** Swedish: 19% Developed: 38% Emerging: 3% **Fixed: 36.9%** **Real: 2.4%** **External: 17.8%**
2010	**Equity: 61.5%** **Fixed: 38.5%** Gov: 40% Corp: 16.5% Inf: 8.3% **External: 9.2%**	**Equity: 57.8%** Swedish: 16% Foreign: 32% Emerge: 10% **Fixed: 32.5%** Swedish: 12% Foreign: 12% Iindex: 8% **Alt.inv: 8%** **External: 43%**	**Equity: 54%** Swedish: 20% Foreign: 35% **Fixed: 35%** Swedish: 19% Foreign: 16% **Alt.inv: 11%** **External: 23%**	**Equity: 55.7%** **Fixed: 14.5%** **Alt.inv: 36.8%** **External: 41%**	**Equity: 59.9%** Swedish: 18.9% Foreign: 41% **Fixed: 34%** **Alt.inv: 2%** **Real: 3.9%** **External: 22%**
2017	**Equity: 66.6%** Develop: 1.4% Emerging: 1.5% **Fixed: 30.8%** Gov: 55% Corp: 24.2% Iinf: 5% **Real: 2.6%** **External: 5.3%**	**Equity: 37.9%** Swedish: 12.9% Developed: 12% **Fixed: 31.7%** Swedish: 12.7% **Real: 12.8%** **Alt.inv: 12.5%** **External: 32%**	**Equity: 42.5%** Swedish: 9.1% Develop: 22.2% Emerge: 11.1% **Fixed: 33.5%** Gov: 4% Corp: 10.4% Emerge: 6.1% **Alt.inv: 24.3%** **External: 17%**	**Equity: 50%** Swedish: 13% Foreign: 31% **Fixed: 32.2%** Swedish: 15% Foreign: 20% **Real: 11%** **Alt.inv: 21.1%** **External: 25%**	**Equity: 58.1%** Swedish: 18% Foreign: 40% **Fixed:32%** **Real: 8%** **Alt.inv: 2%** **External: 17%**

We see from the table that the GPFG has increased their allocation to equity over the sample period, while also decreasing their use of external managers. The AP funds have increased their allocation to alternative investments and real estate, mainly through reductions in equity, over the period.

5. Assessing the Funds' Investment Performance

The focus of this study is to compare the investment approach of the GPFG and the AP funds, however as we see it as inefficient to compare the GPFG to each of the four individual AP funds, we have decided to aggregate the AP funds into one aggregated fund. The individual AP funds have been included to contribute to a more comprehensive analysis. In order to measure and compare the two pension funds' performance, it is necessary to gather data on different investment regulations and restrictions, and supervisory authority, assets under management, portfolio composition, costs and fees, and valuation and methodology used to calculate investment returns.

Particularly, we had to carefully examine how the funds values their managed assets, and needed to consider the potentially different approaches to reporting investment returns. Both pension funds use a valuation methodology which is based on the market value for reporting their returns, but the reporting approaches may differ. According to Yermo (2008) comparing the investment performance of different pension funds, one should ideally compare returns of net investment management costs, but this forced us to address another widely known difference in the computation of returns in different countries, which is the treatment of costs and particularly management fees (Antolin, 2008).

Global Investment Performance Standards (GIPS) is a much-used methodology for performance measures and is the calculation methodology we chose to follow in order to compare the funds. They have recommended methodologies for calculating returns, costs, and risks, and the complementary ratios for comparability.

5.1 Data

5.1.1 Sources of Data

The information needed to conduct our thesis is found in related literature, in government reports, in the funds' financial reports and on their websites. The main source of information and data is found in the financial reports of the funds. In order to compare the numbers and data for the funds, we used exchange rates

found on Thomson Reuters Datastream to convert the numbers into one common currency, the USD. The sample period chosen for this study is from 2002 - 2017, and all data will be in a semi-annual frequency.

Furthermore, we retrieved the LIBOR USD 6-month rate on Thomson Reuters Datastream as the USD-denominated risk-free rate. All the risk-free rates are based on the figure on the last date of the month rate, which is the final trading day of June and December, to be consistent with the semi-annual returns.

5.1.1.1 Sources of Norwegian Data

NBIM publishes quarterly reports for GPFG's performance on their websites, thus the second quarter and the annual reports has been used for this study. The second quarter-report reports year-to-date figures and therefore computations have been made to make the annual report figures semi-annual for consistency. In addition, the Parliament publish public letters, called *stortingsmeldinger*, with information regarding the fund and its performance, which were retrieved when needed.

With regards to the Norwegian figures, the Norwegian consumer price index (CPI) and benchmark indices have been collected from Thomson Reuters Datastream and Bloomberg to complete the analysis. The 6-month NIBOR rate has been used as the Norwegian risk-free rate, collected from Norges Bank (NBIM, 2018b) and Oslo Stock Exchange (Oslo Børs, 2018). All the data has been retrieved in the time period of 31.12.2001 to 31.12.2017 in a semi-annual frequency.

5.1.1.2 Sources of Swedish Data

Data for the AP funds have been found on the respective funds' individual websites through published reports. None of the funds report any quarterly data, but they have published semi-annual reports since 2002. In several attempts to receive more frequent data, requests have been made directly to all the funds, without success. Nonetheless, the reports are available in a semi-annual and annual fashion, so computations have been made to convert all numbers into semi-annual figures.

Thomson Reuters Datastream and Bloomberg has been used to retrieve the USD/SEK exchange rate and the benchmark indices. The Swedish CPI has been retrived from statistikdatabasen.scb.se (2018). The 6-month STIBOR rate has been used as the Swedish risk-free rate and have been collected from the Swedish Riksbank (Riksbanken, 2018). All the data has been retrieved in the time period of 31.12.2001 to 31.12.2017 in a semi-annual frequency.

5.1.2   Limitations of Data

There are some limitations of the data since the GPFG and all the AP funds report their return slightly differently. For example, most of the funds report their active returns to a varying degree. AP1 report their active return semi-annually up until 2009, where then they do not report any active returns until 2011, whereas after they only report this in an annual frequency. This is a tendency that occurs with most of the funds, either because their reporting standards have changed throughout the sample period or because they chose to not disclose certain data, which results in some missing data.

For GPFG, the returns are reported monthly in both USD and NOK, which means that no assumptions of inflow-timing has been made in consideration to the exchange rate. However, the AP funds' returns are not always consistently reported, as it is not always clear exactly when the inflows have occurred throughout the year. We assume that all inflows have occurred at the end of each period when calculating the returns. This results in all net inflows being exchanged to USD at the last date of each semiannual period. This does of course not reflect the true timing of inflows and outflows for the AP funds, but making this assumption was necessary.

To check the robustness of the assumption we compared the USD returns of the AP funds using end of period exchange rates, to the USD returns of the funds using beginning of period exchange rates. The return figures differed greatly on a period-to-period basis, but comparing the average return for the overall period and the sub periods (See exhibit 2 in appendix A), the returns were quite similar which is why we decided to use the end of period exchange rates.

Furthermore, the GPFG has not disclosed the benchmark returns for 2017, which means that we are missing two entries in the dataset for the two periods in 2017. The reason for this is that from 01.01.2017, the Ministry of Finance changed the fund's investment mandate so that all of the fund's investments were measured against one common benchmark, instead of being measured against individual benchmarks. We have chosen to use the fund's return excluding real estate and these two entries has been used in the calculation of certain risk measures, such as the tracking error and the information ratio and the regressions. Thus we have excluded the two semi-annual periods for 2017 from these calculations, which may bias the data somewhat for sub-period 3 and the overall sample period.

5.1.2.1 Limitations of Benchmark

The GPFG has consistently reported their strategic benchmark weights, while this is not the case for the AP funds. In addition, the AP funds have either reported inconsistently or not at all their benchmark, benchmark indices or what their active return is measured against. For example, AP3 constructed in 2012 three different reference portfolio's for three different time horizons. The extent of the data of these three reference portfolios and their weights are available varies greatly, and the data is not consistent throughout the sample.

Due to the inconsistency of the reported benchmarks of the AP funds, we have constructed a benchmark for the AP funds which have been used in calculating the active returns, and will be discussed in section 5.2.1.

5.1.2.2 Limitations of Costs

It appears that both GPFG and AP 1 through 4 have to some degree, a lack of transparency in the approach to calculate fees, particularly related to transaction costs. A report by Swedish Social Insurance Inspectorate on administrative costs concluded that it was difficult to estimate what had been calculated as transaction costs as this can differ across several definitions, and that can be a problem as the public do not know how much that is paid in transaction costs (Fixen, 2016). We have solved this by examining only the total costs of the funds, and not give weight to the different cost-classes, i.e. transaction costs, commission costs and operating costs individually.

5.1.2.3 Limitations of Returns

The treatment and lack of transparency of transaction costs can potentially distort and underestimate the total costs, which again can affect the funds' calculations of return. Due to potential differences in reporting frameworks, valuation methodology and regulatory differences, comparing investment performance using just the pension funds' reported returns may be misleading. We solved this by using the GIPS methodology for calculating their returns our self to ensure consistency across all the funds, which will be discussed in more detail in the computations section. However, there may be minor biases as different methodologies and assumptions may have been taken, such as that the funds may calculate net inflows when they occur, rather by the end of the semi-annual period. This is also the case when converting the numbers to USD for the AP funds, as we do not know exact moment of inflow and outflow, we consistently make the assumption of using the exchange rate at the last trading day.

5.2 Computation of Data

This section will present the methodology, assumptions and calculations that has been made when computing the data. Before getting into the computations of return, cost and risk, it is useful to be aware of how the benchmarks have been calculated, the semi-annualizing of the data and how we have aggregated the four individual AP funds into one fund.

5.2.1 Computation of Benchmark

We also compare how the funds have performed beyond their respective benchmarks, called active return or relative return. Most of all the funds' mandates or strategic goals include achieving a specific amount of active return, which is why it is important to include.

The GPFG consistently report their strategic benchmark weights, active returns, and all figures necessary to find their semi-annual benchmark index. The AP funds on the other hand have inconsistently reported their active return, whereas much of this data is missing or unreliable to a varying degree. The decision has been made to create our own benchmark index for the AP funds. The new benchmark is a simple benchmark index of 60% equity and 40% fixed income. As

the AP funds all invest in Swedish equity, foreign equity, Swedish fixed income and foreign fixed income, all these four asset classes have been included in the benchmark index. Foreign equity and foreign fixed income are further split into two parts, a hedged and an unhedged part.

The weights of the benchmark are based on a combination of a range of permitted intervals found in the annual reports, mandate restrictions prescribed by statute and by taking the average strategic benchmark weights when they intermittently are reported by the funds.

Table 2: Overview of the New Benchmark Index

This table contains an overview of the different indices used to create the benchmark index for a simple and passive benchmark index for the AP funds. Included is the asset classes, indices used, range of permitted intervals found in annual reports, and strategic weights used.

Asset Class	Index	Range	Weights
Swedish Equity	MSCI Sweden	15 - 25%	*15%*
Foreign Equity	MSCI ACWI	20 - 40%	*22,5%*
Swedish Fixed Income	OM Benchmark Total	10 – 25%	*10%*
Foreign Fixed Income	Bloomberg Barclays Global-Aggregate Total Return Index	10 – 20%	*15%*
Foreign Equity Hedged	MSCI ACWI hedged	Maximum 40% foreign currency exposure	*22,5%*
Foreign Fixed Income Hedged	Bloomberg Barclays Global-Aggregate Total Return Index Hedged		*15%*

The range was found in an early annual report, but we decided to weight both the fixed income and equity portions somewhat differently than these intervals, because it better reflects the individual and aggregated fund's development of investing more heavily abroad in the recent years.

The benchmark index is meant to be a simple index for passive investment to see how much better the AP funds perform in comparison, but we also had to include the hedged indices in order to satisfy the fund's mandate of taking on a maximum

of 40% foreign currency exposure. The total foreign currency exposure of the benchmark ends up at 37,5%. The benchmark is calculated as:

$$Benchmark = w_1 * MSCI_{SWE} + w_2 * MSCI_{ACWI} + w_3 * OM_{TOTAL} + w_4 * BB_{TOTAL}$$
$$+ w_5 * MSCI_{ACWI\ hedged} + w_6 * BB_{TOTAL\ hedged}$$

5.2.1.1 Computations of Hedged Indices

For the benchmark to satisfy the permitted intervals and the maximum foreign currency exposure limit, we had to hedge both the foreign equity and foreign fixed income indices. The decision to hedge the indices ourselves was made as we were unable to find any suitable indices that were hedged back to SEK.

In order to hedge the AP funds' exposure to the change in the SEK price of USD, we sold USD forward for SEK for 6 months, that is, we entered a forward contract at t-1 with delivery at time t. By the Covered Interest Rate Parity the forward price has to satisfy:

$$FX_{USD,t-1:t}^{SEK} = X_{USD,t-1}^{SEK} * \frac{(1 + r_{f,t-1}^{SEK})}{(1 + r_{f,t-1}^{USD})}$$

In this case, the hedged return on the index would be:

$$(1 + R_{k,t}^{SEK}) = \left(\frac{Indx_{k,t}^{USD}}{Indx_{k,t-1}^{USD}}\right) * \left(\frac{FX_{USD,t-1:t}^{SEK}}{X_{USD,t-1}^{SEK}}\right)$$

Notation:
- $FX_{USD,t-1:t}^{SEK}$: time t-1 SEK forward of the USD for delivery at time t.
- $X_{USD,t-1}^{SEK}$: SEK price of the USD at time t-1.
- $r_{f,t-1}^{SEK}$: the 6 month STIBOR at time t-1.
- $r_{f,t-1}^{USD}$: the 6 month USD LIBOR at time t-1.
- $R_{k,t}^{SEK}$: the hedged SEK return at time t.
- $Indx_{k,t}^{USD}$: USD value of Index k at time t.

Selling USD forward for 6 months means that we fix the SEK/USD rate we transfer dollars into SEK in 6 months, thus investing in a hedged index does not entail any foreign currency exposure.

5.2.2 Semi-annualizing the Data

The AP funds only publish a semi-annual report in June and an annual report in December. Therefore, computations have been made to semi-annualize the data for the last 6 month of the year by subtracting the semi-annual data from the annual data. All rates, ratios, figures and data have been calculated to be consistent with the semi-annual frequency. The GPFG had available datasets with monthly returns in NOK and USD. We have converted these monthly numbers to semi-annual returns as described in section 5.3.1.

5.2.3 Aggregating the AP Funds

As AP 1 through 4 are different funds with four different annual statements, we have to consider the aggregate return, risk and cost of all four funds to make the GPFG and the AP funds comparable. However, it is also useful to examine each fund in isolation, but it may not be useful for comparable purposes with GPFG, but rather for the overall performance of the Swedish funds. All four funds have the same methodology for reporting and valuation in their annual reports, which enable us to compare the disaggregated costs, return and risks in isolation of the four funds, but also calculate aggregated returns, costs and risks to allow for a comparable study between the aggregated AP fund and GPFG (Severinson and Stewart, 2012).

We have aggregated the funds by weighting the data for all of the funds based on the funds' assets. First we added the total assets of all the funds at the beginning of the period, and then created weights based on how much of the total aggregated assets each of the funds had.

$$Total\ assets_t = assets_{AP1,t} + assets_{AP2,t} + assets_{AP3,t} + assets_{AP4,t}$$

$$weights_t = \frac{assets_{APi,t}}{Total\ assets_t}$$

Example of weighted aggregate return

$$Return_{agg\ AP} = w_{AP1} * R_{AP1} + w_{AP2} * R_{AP2} + w_{AP3} * R_{AP3} + w_{AP4} * R_{AP4}$$

The same methodology has been utilized for all the aggregated data, where the same weights have been used to keep the data consistent. In practice, this means that where applicable, the weights have been used, otherwise we have calculated the numbers, e.g. standard deviation by computing all semi-annual returns, such that the standard deviation is not weighted but based on aggregated figures, which are based on the weights.

5.3 Return Computation

This section describes the computations, methodology and assumptions made for the return calculations. Both the GPFG and the AP funds are compliant with the International Financial Reporting Standards (IFRS).

It is useful to see how investment returns have evolved and developed in the two different countries in isolation. We also make the returns comparable by converting the data into one common currency (Antolin, 2008).

The relevant returns are the semi-annual nominal discrete returns, the semi-annual real return adjusted for inflation and costs, and returns beyond benchmarks, both in domestic-denominated and common currency.

5.3.1 Nominal Discrete Returns

The computations of the semi-annual nominal discrete returns are based on the reported figures. For the GPFG we collected the monthly NOK and USD returns from 2002-2017 and computed them into semi-annual returns by using this formula:

$$R_{p,t} = (1 + MR_t) * (1 + MR_{t+1}) * (1 + MR_{t+2}) * (1 + MR_{t+3}) * (1 + MR_{t+4}) * (1 + MR_{t+5})$$

Where:

- $R_{p,t}$: is the semi-annual returns for the period
- $MR_{p,t}$: is the monthly returns for the month.

For the AP funds, all numbers were reported in SEK and in an semi-annual frequency. For the return computations, data on semi-annual net assets was collected and returns was calculated as follows below.

Nominal discrete returns in domestic currency

When computing the returns, we do not use the total fund value as the starting point, as the funds have had inflows and outflows not related to investment activities during the year. Instead, we look at the profit the funds have created from its investments and calculate it as follows:

$$R_{p,t}^{DOM} = \frac{Profit_t^{DOM}}{Value_t^{DOM}}$$

Where:
- $R_{p,t}^{DOM}$: is the semi-annual nominal discrete returns in domestic currency at time t
- $Profit_t^{DOM}$: is the value of the profit from the fund's investments from period 1 at the end of the period in domestic currency at time t
- $Value_t^{DOM}$: is the total portfolio value at the beginning of the period in domestic currency at time t-1

Nominal discrete returns in USD-denominated currency

$$R_{p,t}^{USD} = \frac{Value_t^{DOM} * X_{DOM,t}^{USD}}{Value_{t-1}^{DOM} * X_{DOM,t-1}^{USD}} - 1 = \left(1 + R_{p,t}^{DOM}\right)(1 + \Delta X_{DOM}^{USD}) - 1$$

Where:
- $R_{p,t}^{USD}$: is the semi-annual nominal discrete returns in USD-denominated currency at time t.

- $R_{p,t}^{DOM}$: is the semi-annual nominal discrete returns in domestic currency at time t.

- $Value_t^{DOM}$: is the total portfolio value at the end of the period in domestic currency at time t.

- $Value_{t-1}^{DOM}$: is the total portfolio value at the end of the last period in domestic currency at time t - 1.

- $X_{DOM,t}^{USD}$: is the USD price of the domestic exchange rate at time t.

- $X_{DOM,t-1}^{USD}$: is the USD price of the domestic exchange rate for the last period at time t - 1.

- ΔX_{DOM}^{USD}: is the change in the USD price of the domestic currency between the last and current time period.

5.3.2   Real Returns

The real return is defined as semi-annual nominal discrete inflation- and cost-adjusted returns. First we calculate the semi-annual inflation. Then we calculate the semi-annual return to find the return beyond inflation and cost. Lastly we convert the real return to USD-denominated currency.

$$Inf_t^{DOM} = \frac{CPI_t^{DOM} - CPI_{t-1}^{DOM}}{CPI_{t-1}^{DOM}}$$

Where:

- Inf_t^{DOM}: is the domestic inflation at time t

- CPI_t^{DOM}: is the domestic consumer price index at time t

- CPI_{t-1}^{DOM}: is the domestic consumer price index at time t-1

$$Real\ Return_{p,t}^{DOM} = R_{p,t}^{DOM} - Inf_t^{DOM} - TC_T^{DOM}$$

Where:

- $Real\ Return_t^{DOM}$: is the real return in the domestic currency adjusted for inflation and costs at time t

- $R_{p,t}^{DOM}$: is the nominal discrete returns in domestic currency at time t.

- Inf_t^{DOM}: is the domestic inflation at time t

- TC_t^{DOM}: is the total cost ratio in domestic currency at time t

$$Real\ Return_t^{USD} = (1 + Real\ Return_t^{DOM})(1 + \Delta X_{DOM}^{USD}) - 1$$

Where:

- $Real\ Return_t^{USD}$: is the USD-denominated real return adjusted for inflation and costs at time t
- $Real\ Return_t^{DOM}$: is the real return in the domestic currency adjusted for inflation and costs at time t
- ΔX_{DOM}^{USD}: is the change in the USD price of domestic currency between the last and current time period.

5.3.3   Return Beyond Benchmark

Below is the methodology used when calculating the returns beyond benchmark, or active returns. First we calculate the semi-annual nominal active returns in domestic-denominated currency, and then convert the returns into the common currency.

Nominal Active Returns in domestic-denominated currency

$$AR_T^{DOM} = R_{p,t}^{DOM} - R_{b,t}^{DOM}$$

Where:

- AR_T^{DOM}: is the active return, or relative return, beyond benchmark return at time t.

- $R_{p,t}^{DOM}$: is the nominal discrete semi-annual return of the fund in domestic currency at time t.

- $R_{b,t}^{DOM}$: is the nominal discrete semi-annual return of the index benchmark in domestic currency at time t.

Nominal Active Returns in USD-denominated currency

First we converted the returns of the funds and the returns of the benchmarks into USD, and then subtracted the index benchmark returns from the fund returns.

$$AR_T^{USD} = R_{p,t}^{USD} - R_{b,t}^{USD}$$

Where:

- AR_T^{USD}: is the active return, or relative return, beyond benchmark return at time t.

- $R_{p,t}^{USD}$: is the nominal discrete semi-annual return of the fund in domestic currency at time t.

- $R_{b,t}^{USD}$: is the nominal discrete semi-annual return of the index benchmark in domestic currency at time

5.4 Risk Computations

This section presents the computations of the different risk measures used in this analysis. Both the GPFG and the AP funds aim to generate the highest possible return on their investment without taking undue risk. To enable us to compare the risks, we needed to identify and measure the risks faced by the two funds.

5.4.1 Standard Deviation

Standard deviation is often referred to as the fund's total or absolute risk, and it provides insight into how much return the fund can be expected to fluctuate over a certain time period under normal market conditions. The standard deviation can provide useful information about the fund's different level of risk during the past for comparable purposes.

$$SD_t = \sqrt{\frac{\sum (R_t - \overline{R_t})^2}{N-1}} * \sqrt{2}$$

Where:

- SD_t: is the annualized standard deviation
- R_t: is the semi-annual log-returns of the fund at time t.
- $\overline{R_t}$: is the average semi-annual log-returns of the fund at time t.

- N: is the number of observations of the sample or sub-period.
- $\sqrt{2}$: in order to annualize the semi-annual standard deviation.

Since standard deviation provides limited insight in the funds' actual performance in isolation, we also use complementary measures of risk. In order to get a comprehensive analysis, the Sharpe ratio, tracking error and information ratio has been utilized to investigate the investment approaches in relation to risk and the risk-return relationships.

5.4.2   Sharpe Ratio

The Sharpe Ratio measures the excess return (or risk premium) per unit of risk in an investment strategy. The Sharpe Ratio can meaningfully assess whether the different pension fund systems obtained a risk premium, or have beaten their own benchmark or risk limit (Antolin, 2008).

For the Sharpe ratio, we have retrieved the 6-month NIBOR, STIBOR and LIBOR USD as the risk-free interest rate for the respective currencies.

$$SR_t^{DOM} = \frac{LR_t^{DOM} - r_{f,6m}^{DOM}}{\sigma_{LR,t}}$$

Where:

- SR_t: is the semi-annual Sharpe ratio in the domestic currency at time t.
- LR_t^{DOM}: is the semi-annual log-return in the domestic currency at time t.
- $r_{f,6m}^{DOM}$: is the 6-month STIBOR or NIBOR risk-free interest rate at time t.
- $\sigma_{LR,t}$: is the standard deviation for the semi-annual log-returns in the domestic-denominated currency.

5.4.3   Tracking Error

The tracking error measures the variability in the deviations of the composites returns from the benchmark returns (NBIM, 2016b). The more variability, the larger is the tracking error, also called active risk. The mandate of the funds do

not necessarily impose a limit of the funds' total risk, but it sometimes set a limit for its relative risk using the tracking error.

$$TE_t^{DOM} = \sqrt{\frac{\sum (R_{p,t}^{DOM} - R_{b,t}^{DOM})^2}{N-1}}$$

Where:

- TE_T^{DOM}: is the semi-annual tracking error in the domestic-denominated currency at time t.
- $R_{p,t}^{DOM}$: is the semi-annual discrete return in the domestic currency at time t.
- $R_{b,t}^{DOM}$: is the semi-annual discrete return of the index benchmark in the domestic currency at time t.

5.4.4 Information Ratio

The fund's information ratio (IR) is the ratio of the fund's average semi-annual relative return to the fund's tracking error. The IR indicates how much relative return has been achieved per unit of relative risk (NBIM, 2017b). The IR can also be used to measure a manager's ability to earn excess returns beyond the benchmark (Grinold and Kahn, 1999).

$$IR_t^{DOM} = \frac{R_{p,t}^{DOM} - R_{b,t}^{DOM}}{TE_t^{DOM}}$$

Where:

- IR_t^{DOM}: is the semi-annual information ratio in the domestic currency at time t.
- $R_{p,t}^{DOM}$: is the semi-annual discrete return in the domestic currency at time t.
- $R_{b,t}^{DOM}$: is the semi-annual discrete return of the index benchmark in the domestic currency at time t.
- TE_t^{DOM}: is the semi-annual tracking error in the domestic currency at time t.

5.5 Cost Computations

As recommended by Yermo (2008), in order to compare pension funds' performance, one should ideally compare returns of net investment management costs. Pension funds incur many costs, however, in order to produce a comparison of the investment performance, only costs associated with the investment activities of pension funds should be netted out. Unfortunately, there is often a lack of consistent and complete available data on investment management cost, such as the lack of complete transparency of the transaction costs and external management fees for both pension funds, which can make the total costs underestimated.

Nonetheless, the best indicator of costs management is total cost, which are costs related to their investment activities (OECD, 2015). But looking at the total costs in isolation will not give a full picture of the fund's management, which is why we need a cost ratio in order to make a comparison. CEM Benchmarking Inc (CEM) (section 5.7.9) recommends using total costs over total assets when comparing pension funds (Regeringen, 2017).

5.5.1   Cost Ratio

$$CR_t = \frac{TC_t}{TA_t}$$

Where:

- CR_t: is the semi-annual cost ratio of total costs over total assets
- TC_t: is the total semi-annual cost of the fund, including all the expenses related to operating the fund and its portfolio at time t.
- TA_t: is the total assets of the fund at the beginning of the period of time t.

5.6 Regressions for Alpha and Beta

Alpha can be seen as measure of a portfolio/investment manager's performance relative to a benchmark, while beta is a measure of a portfolio or security's sensitivity in relation to the same benchmark (Lee, 1999). We have run two regressions, one for all the funds and one for only the AP funds, regression 1 and

regression 2, respectively. Furthermore, we split the two regressions into two parts; one unrestricted and one restricted regression. In both regressions we regress the funds' excess return on the excess return of an equity index and the excess return of a fixed income index.

In regression 1 we used the MSCI ACWI and Bloomberg Barclays Global Aggregate Bond Index as our equity and fixed income index, respectively. In regression 2, we also included the hedged components of the two aforementioned indices. The difference between the unrestricted and restricted regressions is that in the unrestricted regression the betas are free to take any value, but in the restricted regression the sum of the betas is 1, and they can only take positive value, like a style-analysis. This is useful in order to examine whether the investment style differs from the fund's stated style.

5.6.1   Regression 1

Unrestricted:

$$\left(R_{p,t} - R_{f,t}\right) = \alpha + \beta_0\left(R_{MSCI,t} - R_{f,t}\right) + \beta_1\left(R_{BBagg,t} - R_{f,t}\right) + \varepsilon_t$$

Restricted:

$$\left(R_{p,t} - R_{f,t}\right) = \alpha + \beta_0\left(R_{MSCI,t} - R_{f,t}\right) + \beta_1\left(R_{BBagg,t} - R_{f,t}\right) + \varepsilon_t$$
$$s.t.: \beta_0 + \beta_1 = 1$$
$$\beta_0 \geq 0$$
$$\beta_1 \geq 0$$

5.6.2   Regression 2

Unrestricted:

$$\left(R_{p,t} - R_{f,t}\right) = \alpha + \beta_0\left(R_{MSCIuh} - R_{ft}\right) + \beta_1\left(R_{BBaggtuh} - R_{ft}\right) + \beta_2\left(R_{MSCIh} - R_{ft}\right) + \beta_3\left(R_{BBaggh} - R_{ft}\right)$$

Restricted:

$$\left(R_{p,t} - R_{f,t}\right) = \alpha + \beta_0\left(R_{MSCIuh} - R_{ft}\right) + \beta_1\left(R_{BBaggtuh} - R_{ft}\right) + \beta_2\left(R_{MSCIh} - R_{ft}\right)$$
$$+ \beta_3\left(R_{BBaggh} - R_{ft}\right)$$

Subject to:

$$\beta_0 \geq 0$$

$$\beta_1 \geq 0$$

$$\beta_2 \geq 0$$

$$\beta_3 \geq 0$$

$$\sum \beta_i = 1$$

5.7 Comparisons

This section will compare the funds' performance in terms of return, risk and costs in the period 2002 – 2017. The comparisons have been done in three sub-periods and for the overall sample period, where the main focus is to compare GPFG to the aggregated AP fund. To further comprehensively examine the results of the aggregated AP fund, the individual AP fund's performance, cost and risks have also been included.

Sub-period 1 is the earliest period, from 2002 to 2007, sub-period 2 is the period from 2008-2012, which will include the financial crisis and its aftermath, and the final period, is sub-period 3, which is 2013 - 2017.

5.7.1   Returns

The first table shows the returns of the GPFG, aggregated AP fund and individual AP funds. The nominal returns are the average semi-annual returns before expenses and the real return is defined as inflation-adjusted return after costs. The nominal and real returns have been converted into a common currency, the USD.

Table 3: Overview of Returns

This table reports the returns of the GPFG and the AP funds, both in local and USD denominated currency, as nominal and real return for the overall sample periods, and for the three sub-periods, 2002-2007, 2008-2012 and 2013-2017. The nominal returns are the discrete semi-annual nominal returns before cost, while the real return is return adjusted for inflation and cost.

	GPFG	Aggregated AP	AP1	AP2	AP3	AP4
Domestic Currency: Nominal Semi-Annual Returns						
Overall	3,53%	3,48%	3,41%	3,50%	3,45%	5,59%
Sub-period 1	1,62%	3,68%	3,71%	3,94%	3,83%	3,22%
Sub-period 2	1,60%	1,61%	1,63%	1,63%	1,23%	1,97%
Sub-period 3	7,75%	5,12%	4,81%	4,84%	5,19%	5,66%
USD Currency: Nominal Semi-Annual Returns						
Overall	3,99%	4,93%	4,87%	4,99%	4,87%	5,01%
Sub-period 1	5,76%	8,42%	8,46%	8,70%	8,59%	7,93%
Sub-period 2	2,13%	2,77%	2,82%	2,87%	2,31%	3,11%
Sub-period 3	3,72%	2,91%	2,60%	2,65%	2,97%	3,42%
Domestic Currency: Semi-Annual Real Return						
Overall	2,51%	2,82%	2,74%	2,83%	2,78%	2,94%
Sub-period 1	0,63%	2,80%	3,26%	3,06%	2,95%	2,35%
Sub-period 2	0,71%	0,94%	0,94%	0,94%	0,56%	1,32%
Sub-period 3	6,58%	4,72%	4,40%	4,43%	4,80%	5,27%
USD Currency: Semi-Annual Real Return						
Overall	2,96%	4,22%	4,15%	4,27%	4,16%	4,32%
Sub-period 1	4,72%	7,49%	7,53%	7,76%	7,66%	7,00%
Sub-period 2	1,26%	2,03%	2,08%	2,12%	1,57%	2,38%
Sub-period 3	2,57%	2,50%	2,18%	2,23%	2,57%	3,03%

Looking first at the *nominal returns* in the domestic currency, the GPFG has slightly higher returns for the overall period than the aggregated AP fund. In sub-period 1, the aggregated AP fund outperform the GPFG, while in the second period they are relatively similar, and in the last period, the GPFG outperform the AP fund. GPFG does not invest domestically, and the large returns in sub-period 3 might be due to favorable exchange rates. In the USD-denominated currency, the aggregated AP fund achieves higher overall nominal returns than the GPFG,

which they also have in sub-period 1 and 2, whilst in sub-period 3, the GPFG outperform the AP fund. The results shows that the GPFG has a stronger performance in the most recent years, which might suggest that they have taken advantage of the strong equity market after the financial crisis to a larger extent than the AP funds.

Examining the real returns, the domestic currency returns show that the GPFG is underperforming compared to the AP funds until the third sub-period where they gain stronger returns. This is also the case in the USD-denominated currency, however the differences in return in sub-period 3 is less apparent than in the domestic currency. However, considerations must be made for the fact that inflation in Norway has been higher, and that the Swedish inflation has been negative in some years.

When investigating the contribution of individual AP funds to the total aggregated return, AP4 has consistently delivered the highest return of all the funds except sub-period 1, however all the funds deliver very similar returns

5.7.2   Standard Deviation

The standard deviation is one of the most common risk measures, and is the
square root of the variance of the log-returns.

Table 4: Overview of Standard Deviation

*This table contains the annualized standard deviation of the GPFG and AP funds, both in
domestic and USD denominated currency. The standard deviation is based on the log-returns
before cost of the funds and is for the overall sample periods, and for the three sub-periods, 2002-
2007, 2008-2012 and 2013-2017.*

	GPFG	Aggregated AP	AP1	AP2	AP3	AP4
Domestic Currency						
Overall	9,25%	8,78%	8,69%	9,51%	8,05%	9,04%
Sub-period 1	10,99%	8,99%	8,64%	9,57%	8,13%	9,71%
Sub-period 2	6,85%	11,82%	12,06%	13,18%	10,52%	11,64%
Sub-period 3	6,78%	3,39%	3,25%	3,42%	3,60%	3,77%
USD Currency						
Overall	12,42%	17,32%	17,45%	18,16%	16,69%	17,06%
Sub-period 1	6,27%	11,68%	11,55%	12,08%	11,26%	11,96%
Sub-period 2	19,98%	26,84%	27,19%	28,21%	25,53%	26,45%
Sub-period 3	7,87%	9,32%	9,23%	9,76%	9,28%	9,21%

Looking at the standard deviation in the domestic currency, we see that the GPFG
has a slightly higher standard deviation in the overall period than the aggregated
AP fund. In the first sub-period the GPFG has the highest standard deviation of
the two funds. In sub-period 2, while the aggregated AP fund have a high standard
deviation, the GPFG is able to have relatively low variability, which may suggest
that they were able to face the obstacles of the financial crisis better in terms of
managing risks than the AP funds. While GPFG have the same level of variability
into the third period, the AP funds are able to lower their variability across all
funds, with an even lower standard deviation than GPFG.

Looking at the standard deviation in the common currency, we can see that the
standard deviation of all the funds is notably higher in the common currency than
in their respective domestic currencies. Contrary to the results in the domestic
currency, the aggregated AP fund has the highest standard deviation, in all

periods, compared to the GPFG in the common currency. GPFG's standard deviation is no longer consistent in sub-period 2 and 3, and even though the aggregated AP fund is able to significantly decrease the standard deviation from sub-period 2 to 3, it is no longer below the variability level of the GPFG.

5.7.3 Sharpe Ratio

We have utilized the Sharpe ratio of the funds for the sub-periods to obtain a more comprehensive analysis of the risk-return relationship. The Sharpe ratio is used to represent the trade-off between risk and return by investigating the reward by taking on additional risk.

Table 5: Overview of Sharpe Ratio

This table reports the semi-annual Sharpe ratio of the GPFG and the individual and aggregated AP funds, both in local and USD denominated currency.

	GPFG	Aggregated AP	AP1	AP2	AP3	AP4
Domestic Currency						
Overall	0,04	0,20	0,19	0,18	0,22	0,21
Sub-period 1	-0,32	0,07	0,08	0,10	0,11	0,00
Sub-period 2	-0,42	-0,14	-0,14	-0,13	-0,20	-0,10
Sub-period 3	1,24	1,94	1,89	1,81	1,85	1,93
USD Currency						
Overall	0,20	0,19	0,18	0,18	0,20	0,20
Sub-period 1	0,56	0,57	0,59	0,58	0,62	0,50
Sub-period 2	-0,01	-0,01	-0,01	-0,01	-0,03	0,01
Sub-period 3	0,51	0,30	0,26	0,25	0,31	0,38

Examining the Sharpe ratios in the domestic currency, the aggregated AP fund is delivering a higher Sharpe ratio in the overall period and in all the sub-periods. All the funds have improved their Sharpe ratios in sub-period 3 compared to the two previous sub-periods. Furthermore, all the funds have negative Sharpe ratios in sub-period 2, due to low returns and high volatility during the financial crisis. Except for this period, the other high ratios for the AP funds are due to lower standard deviation, and lower risk free rates, especially in sub-period 3 where the risk free rate at times were negative.

For the Sharpe ratios in the common currency, the GPFG has a slightly higher ratio than the aggregated AP fund for the overall sample period. This is likely due to the fact that the GPFG has lower volatility compared to the AP funds' in the common currency. Looking at sub-period 2, the ratios are less negative than in the local currency. In sub-period 2 all the funds have improved their Sharpe ratios from the previous period, with GPFG delivering the highest ratio. AP4 is the only fund with positive, albeit low, Sharpe ratio during sub-period 2, indicating that they may handle the obstacles of financial distress better than the other funds.

5.7.4 Active Returns

The next section will look at the funds' performance in excess of their respective benchmarks. For GPFG, their active returns are the ones reported by NBIM, while for the AP funds we have utilized the hypothetical benchmarks to calculate the active return. However, NBIM has not reported the benchmark returns for 2017, and thus the overall period and sub-period 3 will not include data for 2017.

Table 6: Overview of Active Returns

This table reports the semi-annual active returns of the GPFG, the aggregated AP funds, and the individual AP funds beyond their respective benchmarks, both in local and USD denominated currency. The nominal active return is the discrete semi-annual nominal return before cost, and real return is nominal discrete returns adjusted for inflation and cost over the entire sample period, and for the three sub-periods. **Note:** for GPFG benchmark returns for 2017 are not available, the overall period and sub-period 3 thus includes data from 2002 - 2016 and 2012 - 2016, respectively.

	GPFG	Aggregated AP	AP1	AP2	AP3	AP4
Domestic Currency						
Overall	0,10%	0,90%	0,82%	0,92%	0,86%	1,01%
Sub-period 1	0,19%	1,06%	1,09%	1,32%	1,21%	0,60%
Sub-period 2	0,01%	0,23%	0,25%	0,25%	-0,15%	0,59%
Sub-period 3	0,10%	1,39%	1,07%	1,11%	1,46%	1,93%
USD Currency						
Overall	0,15%	0,96%	0,89%	1,01%	0,90%	1,04%
Sub-period 1	0,19%	1,12%	1,16%	1,40%	1,29%	0,63%
Sub-period 2	0,15%	0,38%	0,43%	0,49%	-0,08%	0,72%
Sub-period 3	0,10%	1,34%	1,02%	1,08%	1,40%	1,85%

In the domestic currency, the aggregated AP fund delivers considerably greater active returns than GPFG, both in the overall period, and in each sub-period. AP4 is the fund which has delivered the highest active return out of all the individual AP funds except sub-period 1. All the AP funds have consistently delivered active returns close to 1% in the overall sample period.

When investigating the active returns in the common currency, the pattern remains the same as in the domestic currency, where GPFG delivers lower active returns in both the overall period and the sub-periods compared to the aggregated AP fund.

5.7.5   Benchmark Returns

As the AP funds' benchmark is constructed as a simple, passive index, the greater active returns achieved by the AP funds could potentially be because their benchmark index is favorable to obtain unjustified larger active returns. As it is not efficient to compare the GPFG's return to the benchmark return of the AP funds, we have compared the returns of the benchmarks to see how they perform in comparison to each other. However, NBIM has not reported the benchmark returns for 2017, and thus the overall period and sub-period 3 will not include data for 2017.

Table 7: Overview of Benchmark Returns

This table shows an overview of the returns of the respective benchmarks for GPFG and the AP funds. The returns are for the entire sample period and for the different sub-periods, both in the domestic currency and the local currency. **Note**: The GPFG benchmark returns for 2017 are not available, the overall period and sub-period 3 thus includes data from 2002 - 2016 and 2012 - 2016, respectively.

	Domestic Currency		Common Currency	
	GPFG	**AP**	**GPFG**	**AP**
Overall	3,21%	2,58%	3,46%	3,98%
Sub-period 1	1,43%	2,62%	5,57%	7,30%
Sub-period 2	1,59%	1,38%	1,97%	2,39%
Sub-period 3	7,89%	3,73%	2,15%	1,57%

The benchmark for the GPFG has higher returns in the overall period in domestic currency, which in theory would make achieving higher active returns for the AP funds easier. The GPFG benchmark achieves higher returns than the AP

benchmark except for sub-period 1. However, this is not the case in the common currency, where the benchmark for the Swedish fund's deliver higher overall returns. The AP funds' benchmark returns are higher than GPFG's except for sub-period 3.

In conclusion we see no evidence that the constructed benchmark allow the AP funds to obtain larger unjustified active returns, as they achieve higher active returns regardless of whether the benchmark returns is higher or lower than the GPFG's, in the common currency.

5.7.6 Tracking Error

The next measure is the tracking error, which measures the standard deviation of the excess return between the funds and their respective benchmarks.

Table 8: Overview of Tracking Error

This table reports the semi-annual tracking error of the GPFG and the individual and aggregated AP funds, both in local and USD denominated currency. **Note:** for GPFG benchmark returns for 2017 are not available, the overall period and sub-period 3 thus includes data from 2002 - 2016 and 2012 - 2016, respectively.

	GPFG	Aggregated AP	AP1	AP2	AP3	AP4
Domestic Currency						
Overall	1,31%	2,20%	2,29%	2,67%	2,55%	2,18%
Sub-period 1	0,44%	1,81%	1,75%	2,07%	2,28%	1,84%
Sub-period 2	2,21%	3,04%	3,31%	4,10%	2,88%	2,51%
Sub-period 3	0,69%	1,33%	1,55%	0,97%	2,06%	1,80%
USD Currency						
Overall	1,14%	2,03%	2,12%	2,39%	2,56%	2,03%
Sub-period 1	0,46%	2,00%	1,98%	2,22%	2,59%	1,98%
Sub-period 2	1,90%	2,55%	2,77%	3,43%	2,71%	2,10%
Sub-period 3	0,62%	1,26%	1,52%	0,94%	1,98%	1,70%

The results show that the GPFG has a lower tracking error than the aggregated AP fund across both currencies throughout all the periods. This indicates that the GPFG is performing more similar to their benchmark index than the aggregated AP fund. In sub-period 2 all the funds increased their tracking error considerably

in both currencies, likely due to the financial distress in this sub period. In sub-period 3 all the funds decreased their tracking error relative to the previous period.

Both GPFG and the AP funds have limits on how much they are allowed to deviate from their benchmark. Before the financial crisis their mandates state that the tracking error should not exceed 1,5% and 3% for GPFG and the AP funds, respectively. Thus the pattern we see in the table above is supported by the respective funds' mandate (see exhibit 4 in appendix A).

5.7.7   Information Ratio

To investigate the results further, we have used an information ratio (IR), which is often used to measure a manager's ability to earn excess return while also adjusting for risk.

Table 9: Overview of Information Ratio

This table reports the semi-annual information ratio of the GPFG and the individual and aggregated AP funds, both in local and USD denominated currency. **Note:** for GPFG benchmark returns for 2017 are not available, the overall period and sub-period 3 thus includes data from 2002 - 2016 and 2012 - 2016, respectively.

	GPFG	Aggregated AP	AP1	AP2	AP3	AP4
		Domestic Currency				
Overall	0,08	0,41	0,36	0,35	0,34	0,46
Sub-period 1	0,43	0,59	0,63	0,64	0,53	0,33
Sub-period 2	0,00	0,07	0,08	0,06	-0,05	0,23
Sub-period 3	0,14	1,05	0,69	1,15	0,71	1,07
		USD Currency				
Overall	0,14	0,47	0,42	0,42	0,35	0,51
Sub-period 1	0,41	0,56	0,59	0,63	0,50	0,32
Sub-period 2	0,08	0,15	0,16	0,14	-0,03	0,34
Sub-period 3	0,16	1,06	0,67	1,15	0,71	1,09

Overall, we see that GPFG has a lower information ratio than the AP funds, in the domestic currency. This indicates that given the risk of the investments, the GPFG earns the lowest active return of all the funds. The information ratio follows the same pattern in the common currency. The AP funds have, as previously

mentioned, focused more on achieving active returns than GPFG, which is reflected in their TE limits and consequently in their higher information ratio.

Of all the individual AP funds, AP4 delivers the highest IR across both currencies on an overall-basis, which has a positive effect on the aggregated AP fund, indicating that AP4 has a strong ability to earn excess return.

5.7.8 Regressions

In this section we run two separate regressions, one for all the funds and one for the AP funds only, regression 1 and regression 2, respectively. In both regressions we regress the returns of the individual funds in excess of the 6 month USD LIBOR, on the excess returns of explanatory variables that will be explained more in detail above each individual regression. These two regressions are split into two parts; one unrestricted and one restricted regression. From the unrestricted regression we are able to assess the performance of the funds, and from the restricted regression we are able to comment on the individual funds' style.

In the unrestricted regression the betas are free to take any value, and the total beta can be seen as a measure of the fund's volatility in relation to the benchmark. The alpha in this regression can be seen as a measure of the fund's ability to earn excess returns.

Under the restricted regression the betas are no longer free to take any value and this is because we have restricted the total beta to take a value of 1. This means that total beta is not a measure of the fund's volatility in the restricted regression, and therefore no longer the measure of interest. In this regression the individual beta coefficients are more interesting since they give us the ability to assess the fund's style.

5.7.8.1 Regression 1

In this regression we regress GPFG, the aggregated AP fund and all the individual AP fund's returns in excess of USD LIBOR on the excess return of the MSCI ACWI and the Bloomberg Barclays Global-Aggregate Total Return Index. We have two varieties of the first regression, one unrestricted and one restricted

regression. The regressions are not categorized into sub-periods, only an overall period.

5.7.8.1.1 Unrestricted Regression

$$\left(R_{p,t} - R_{f,t}\right) = \alpha + \beta_0\left(R_{MSCI,t} - R_{f,t}\right) + \beta_1\left(R_{BBagg,t} - R_{f,t}\right) + \varepsilon_t$$

The unrestricted regression will give us the ability to assess whether the fund is more or less volatile than the benchmark, and whether or not the funds are able to generate active return.

Table 10: Unrestricted Regression (Performance Analysis)

This table reports the results of the unrestricted regression for the GPFG and the individual and aggregated AP funds, only in USD denominated currency. * indicates that the coefficient variable is statistically significant from zero at the 10% level, ** at 5% level and *** at 1% level for a two-tailed significance test. SE is the standard error and T-stat is the t-statistics for the coefficients.

	GPFG	Aggregated AP	AP1	AP2	AP3	AP4
Total Beta	1,215	1,680	1,748	1,747	1,606	1,619
β_0	0,646	0,832	0,823	0,871	0,789	0,847
SE	0,032	0,056	0,056	0,058	0,061	0,053
T-stat	20,38***	14,815***	14,685***	15,115***	12,985***	15,956***
β_1	0,569	0,847	0,925	0,877	0,817	0,772
SE	0,090	0,159	0,158	0,163	0,172	0,150
T-stat	6,351***	5,334***	5,839***	5,381***	4,758***	5,140***
α	0,009	0,014	0,013	0,014	0,014	0,015
SE	0,004	0,007	0,007	0,007	0,007	0,006
T-stat	2,421**	2,118**	1,958*	2,040*	1,984*	2,422**

Looking at the alphas, we see that they are above zero for both the GPFG and the aggregated AP fund, and both are statistically significant at the 5% level. This indicates that the GPFG and AP funds generate a positive performance relative to the benchmark.

Beta is a measure of the fund's systematic risk in relation to the benchmark. A total beta above 1 indicates that the portfolio or fund is more volatile than the

benchmark, while a beta smaller than 1 indicates that the fund is less volatile than the benchmark. A fund with beta above 1 can also be seen as a levered position on world equity and fixed income, where equity beta (β_0) is the portfolios position in equity and fixed income beta (β_1) is the portfolios position in fixed income. The portfolio is levered by borrowing total beta minus 1 of the portfolios assets. Both the GPFG and the aggregated AP fund have total betas above 1, with the aggregated AP fund and the individual AP funds having very large total betas, meaning that they are more volatile than their benchmark. The individual beta coefficients are significant at the 1% level for both GPFG and the aggregated AP fund.

An active versus a passive strategy entails taking on more risk, and thus more volatility. If we compare the GPFG and the aggregated AP fund in terms of total beta, one can see that the aggregated AP fund is more volatile. This may indicate that the AP funds have a more active strategy than the GPFG.

The total betas of the AP funds suggest that they have portfolios that are levered by about 60%, which seems unrealistic. Even though both the equity and fixed income betas for the AP funds are significant at the 1% level, the volatility of the indices do not seem to match the volatility of returns of the Swedish funds. We therefore decided to run a second regression (Regression 2) for the AP funds that includes the hedged indices, to see whether that fit would be better.

5.7.8.1.2   Restricted Regression

$$\left(R_{p,t} - R_{f,t}\right) = \alpha + \beta_0\left(R_{MSCI,t} - R_{f,t}\right) + \beta_1\left(R_{BBagg,t} - R_{f,t}\right) + \varepsilon_t$$
$$s.t.: \beta_0 + \beta_1 = 1$$
$$\beta_0 \geq 0$$
$$\beta_1 \geq 0$$

The purpose of the restricted regression is to perform a type of style analysis in order to see whether the style found from the regression is the same as the fund's stated style, where the equity beta and the fixed-income beta sum to 1.

Table 11: Restricted Regression (Style Analysis)

This table reports the results of the restricted regression for the GPFG and the individual and aggregated AP funds, only in USD denominated currency. Restriction: equity and fixed income beta sum to 1. * indicates that the coefficient variable is statistically significant from zero at the 10% level, ** at 5% level and *** at 1% level for a two-tailed significance test.

	GPFG	Aggregated AP	AP1	AP2	AP3	AP4
Total Beta	1,000	1,000	1,000	1,000	1,000	1,000
β_0	0,634	0,794	0,781	0,829	0,755	0,813
SE	0,035	0,072	0,075	0,076	0,073	0,067
T-stat	18,240***	11,038***	10,447***	10,920***	10,371***	12,118***
β_1	0,366	0,206	0,219	0,171	0,245	0,187
SE	0,098	0,203	0,211	0,215	0,206	0,190
T-stat	3,725***	1,011	1,036	0,798	1,192	0,989
α	0,011	0,019	0,019	0,020	0,019	0,020
SE	0,004	0,009	0,009	0,009	0,009	0,008
T-stat	2,597**	2,245**	2,095**	2,165**	2,177**	2,496**

Alphas for GPFG and the aggregated AP fund are all positive, and compared to the unrestricted regression the alphas are also larger. Thus the funds, including the individual AP funds, perform better than the benchmark.

Over the period, 2002-2017, the stated style of the funds have changed (see table 1 section 4.4). For GPFG the allocations have changed from a more strict 40/60 equity/fixed income split, to investing more heavily in equity, almost 67% in 2017. The equity beta of 0,634 and the fixed income beta of 0,366 seem to be somewhat consistent with the stated style of the GPFG, even though the style has changed over the years. These coefficients are also significant at the 1% level.

The stated style of the aggregated AP fund is harder to grasp since it is a fictitious fund, and we therefore find it more useful to analyze whether the individual AP funds are consistent with their stated style. All the individual AP funds allocated between 30 to 40 percent of their assets to fixed income in 2002, and in 2017 the allocation was between 31 and 34 percent. Comparing the stated style to the

regression results there is a lack of consistency. The regression returns fixed income betas of around 0,2, which is far less than the stated 30% allocation, but none of the coefficients are significant for the AP funds. This, and the equity betas of around 0,8, which all are significant at the 1% level, indicates that the individual AP funds, and in effect the aggregated AP fund, invest more heavily in equity or equity- like investments than stated.

A potential explanation for the difference between the stated and actual investment style could be that as they have increased their exposure to alternative investments, as these investments could be equity-like, such as investments in private equity which generally have high betas. This would then allow them to skew the results and get more equity exposure than they should, as the regression is unable to separate these and therefore include them as equity investments.

5.7.8.2 Regression 2

The AP fund's total betas in the unrestricted regression above were unrealistically large. We therefore decided to run another regression that more closely reflects the benchmark of the AP funds. The dependent variable is still the fund's return in excess of USD LIBOR, but the regression now includes two additional explanatory variables. In the two following regressions β_0 is the coefficient for unhedged MSCI ACWI, β_1 is the coefficient for unhedged Bloomberg Barclays Global-Aggregate (BB), and β_2 and β_3 are the hedged MSCI ACWI and BB indices, respectively.

5.7.8.2.1 Unrestricted Regression

$$\left(R_{p,t} - R_{f,t}\right) = \alpha + \beta_0\left(R_{MSCIuh} - R_{ft}\right) + \beta_1\left(R_{BBaggtuh} - R_{ft}\right) \\ + \beta_2\left(R_{MSCIh} - R_{ft}\right) + \beta_3\left(R_{BBaggh} - R_{ft}\right)$$

As mentioned above, the unrestricted regression will give us the opportunity to assess whether the fund is more or less volatile than the benchmark, and whether or not the funds are able to generate active returns.

Table 12: unrestricted regression (Performance Analysis)

This table reports the results of the unrestricted regression for the individual and aggregated AP funds, only in USD denominated currency, on the new benchmark using both hedged and unhedged indices. * indicates that the coefficient variable is statistically significant from zero at the 10% level, ** at 5% level and *** at 1% level for a two-tailed significance test.

	Aggregated AP	AP1	AP2	AP3	AP4
Total beta	0,729	0,820	0,793	0,595	0,713
β_0	0,619	0,698	0,629	0,658	0,485
SE	0,142	0,145	0,175	0,149	0,158
T-stat	4,347***	4,805***	3,592***	4,410***	3,061***
β_1	-0,458	-0,431	-0,407	-0,665	-0,316
SE	0,142	0,145	0,175	0,149	0,158
T-stat	-3,283***	-3,031***	-2,372**	-4,560***	-0,496
β_2	0,016	-0,070	0,044	-0,081	0,180
SE	0,139	0,142	0,171	0,146	0,155
T-stat	0,116	-0,492	0,260	-0,558	1,164
β_3	0,552	0,623	0,526	0,684	0,364
SE	0,126	0,129	0,155	0,132	0,141
T-stat	4,367***	4,837***	3,385***	5,174***	2,594**
α	0,011	0,010	0,011	0,011	0,012
SE	0,002	0,002	0,003	0,002	0,003
T-stat	4,684***	4,312***	3,705***	4,631***	4,453***
Total Eq. Beta	0,635	0,628	0,674	0,576	0,664
Total FI Beta	0,094	0,192	0,119	0,019	0,048
Currency Exp	0,162	0,267	0,223	-0,008	0,169

Alphas indicate that all the funds perform better than the benchmark, and all the alphas are statistically significant at the 1% level.

Contrary to the results in the unrestricted regression 1, the total betas of the AP funds are now less than one. As we mentioned earlier, this indicates that the funds are less volatile than the benchmark. Since the two new explanatory variables are just hedged versions of the two others, there is a high linear relation between them, that is, high correlation (See exhibit 6 in appendix B). This, in turn, is an

indication of multicollinearity. But multicollinearity does not affect the overall fit of the model, that is, overall prediction is not affected, but the interpretation of and conclusion based on the individual regression coefficients may be misleading (Mason & Perreault, 1991).

As mentioned above, the total beta, which is the coefficient of interest and based on the theory above should not be affected by the multicollinearity, is now below 1. This suggests that AP is less volatile than the benchmark. Usually, a benchmark like this should be passive and therefore less volatile than an actively managed portfolio. This may indicate that the benchmark is not appropriate for the AP funds, or that the hedging strategy of the AP funds work. That is, when you hedge you want less volatility which the low beta indicates they achieved. Drawing a definite conclusion as to why the low beta occur when using the hedged indices is difficult, nonetheless the change in benchmark has clearly influenced the beta from being more volatile in the first regression, to less volatile in the second regression.

5.7.8.2.2 Restricted Regression

$$\left(R_{p,t} - R_{f,t}\right) = \alpha + \beta_0\left(R_{MSCIuh} - R_{ft}\right) + \beta_1\left(R_{BBaggtuh} - R_{ft}\right) \\ + \beta_2\left(R_{MSCIh} - R_{ft}\right) + \beta_3\left(R_{BBaggh} - R_{ft}\right)$$

Subject to:

$$\beta_0 \geq 0$$

$$\beta_1 \geq 0$$

$$\beta_2 \geq 0$$

$$\beta_3 \geq 0$$

$$\sum \beta_i = 1$$

In this regression we restrict the total beta to be equal to 1 in order to see whether or not the AP funds comply with their stated style. All the returns, both for the dependent and the independent variables are in excess of the USD LIBOR.

Table 13: restricted regression (Style Analysis)

This table reports the results of the unrestricted regression for the individual and aggregated AP funds, only in USD denominated currency, on the new benchmark using both hedged and unhedged indices. Restriction: equity and fixed income beta, hedged and unhedged, sum to 1. * indicates that the coefficient variable is statistically significant from zero at the 10% level, ** at 5% level and *** at 1% level for a two-tailed significance test.

	Aggregated AP	AP1	AP2	AP3	AP4
Total beta	1,000	1,000	1,000	1,000	1,000
β_0	0,525	0,504	0,498	0,537	0,561
SE	0,176	0,169	0,195	0,213	0,184
T-stat	2,988***	3,238***	2,778***	2,750***	3,321***
β_1	0,000	0,000	0,000	0,000	0,000
SE	0,172	0,152	0,176	0,191	0,165
T-stat	0,000	0,000	0,000	0,000	0,000
β_2	0,148	0,150	0,204	0,095	0,142
SE	0,172	0,152	0,175	0,191	0,165
T-stat	0,860	0,984	1,166	0,498	0,863
β_3	0,327	0,347	0,297	0,368	0,296
SE	0,156	0,138	0,159	0,173	0,150
T-stat	2,100**	2,513**	1,869*	2,124**	1,978*
α	0,010	0,009	0,010	0,010	0,012
SE	0,003	0,003	0,003	0,003	0,003
T-stat	3,515***	3,593***	3,321***	3,182***	4,133***
Total Eq. Beta	0,673	0,653	0,703	0,632	0,704
Total FI Beta	0,327	0,347	0,297	0,368	0,296
Currency Exp	0,525	0,504	0,498	0,537	0,561

As we have mentioned earlier, the style of the individual AP funds have changed over the period. Looking at the total equity and fixed income betas, the aggregated fund seems to allocate around 67% to equity and 33% to fixed income. The individual AP funds all seem to slightly underinvest in fixed income and overinvest in equity. As mentioned above, the all AP funds invests a significant portion of assets in alternatives, which might explain the overinvestment in equity.

As mentioned above, there are indications of the presence of multicollinearity in this regression. Multicollinearity does not affect the overall fit of the model, but when explanatory variables are closely related it becomes difficult to observe each individual variables contribution to the overall fit (Brooks, 2008). The reason for this is that "near multicollinearity will make confidence intervals for the parameters very wide, and significance tests might therefore give inappropriate conclusions, which in turn makes it difficult to draw inferences" (Brooks, 2008). Thus, a style analysis where the individual explanatory variables are the focal point is not useful.

5.7.9 Costs

This section will give an overview of the total costs in relation to assets. We utilized the same ratio as the fund's themselves use and as recommended by GIPS, total costs over total assets.

CEM Benchmarking Inc. has created general cost benchmarks based on fund's asset mix for large pension funds for comparable purposes. CEM Benchmarking Inc. (CEM) is a global benchmarking company that independently provides objective and actionable benchmarking information about, among other things, pension funds and sovereign wealth funds (CEM, 2018). These benchmarks are based on a peer group which consists of the largest funds in the CEM survey, which we have utilized to compare costs management across several countries (NBIM, 2011).

Table 14: Overview of Total Costs

This table reports the semi-annual total costs ratios of the GPFG and the AP funds. The total cost ratio is based on the semi-annual total cost for the funds and is reported for the different sub-periods of the sample period.

	GPFG	Aggregated AP	AP1	AP2	AP3	AP4
Overall	0,04%	0,07%	0,08%	0,08%	0,08%	0,06%
Sub-period 1	0,05%	0,08%	0,08%	0,08%	0,09%	0,07%
Sub-period 2	0,05%	0,07%	0,07%	0,08%	0,07%	0,05%
Sub-period 3	0,03%	0,07%	0,08%	0,08%	0,06%	0,05%
Annual ratio 2017	0,06%	0,12%	0,14%	0,15%	0,10%	0,10%

Overall, the numbers indicate that the GPFG is the most cost-efficient fund at almost half the cost ratio of the other AP funds, although the costs of the aggregated AP fund is not very large. Except for a decrease in cost level in sub-period 3, the cost level of the GPFG has remained relatively stable over the years, as the costs of the fund have increased more or less in line with assets. We should also consider that if the AP funds did have a single-fund structure in practice, many of the overhead costs and costs in general could potentially be reduced, which is difficult to calculate in practice and therefore difficult to hypothetically conclude which fund is more cost-efficient.

AP3 and AP4 has a positive trend of lowering their costs over the years, which does not seem to be the case for AP1 and AP2, even though the size of the funds has increased relatively similarly. Out of all the individual AP funds, AP4 seems to be the most cost-efficient, but this will be investigated further by looking at the external management fees to see if that can explain the different cost levels.

NBIM has previously utilized CEM's peer cost benchmarks in their own assessment of cost management of the fund. CEM's cost benchmarks is based on a peer group consisting of nine large institutional investors, and are some of the largest comparable funds in the CEM database. There are no historical cost benchmark numbers available, but the most recent data in the report shows that on average, the peer group has an annualized cost ratio of 0.16%, and peer groups with similar management styles to GPFG has an annualized cost ratio of 0.09% (Regjeringen, 2017). These numbers indicate that GPFG managed their costs better than their peers in 2017, while the AP funds managed their cost better than the first group but worse than the second.

5.7.9.1 External Management Costs

For a more in-debt analysis of costs, this section will look at the external management fees of the individual AP funds to see if these have any explanatory power for the differences in amount of total cost.

Both the AP funds and GPFG uses external managers for parts of the funds' investments, which is also an investment requirement from the funds' mandates.

The fee to the external manager are normally structured so that they comprise of a fixed component and a performance-based component which is dependent on the manager's ability to generate excess return (NBIM, 2016).

We have looked at the external management fees of the AP funds and the share of the total portfolio that is managed by external managers. The numbers have been found in the annual reports of the AP funds, and we have summarized these into sub-periods and for the overall sample period for each of the individual AP funds.

Table 15: External Management Costs for the AP Funds

This table reports the external management costs of the individual AP funds, both as the management fees paid to external managers in mill SEK, and the percentage of the total portfolio that is managed by external managers.

	AP1	AP2	AP3	AP4
External Management Fees (in mill SEK)				
Overall	144,88	185,19	129,88	65,25
Sub-period 1	92,83	133,17	120,17	65,50
Sub-period 2	112,80	181,40	121,00	22,60
Sub-period 3	239,40	251,40	150,40	104,40
Share of External Managers				
Overall	34,90%	26,25%	34,88%	22,0%
Sub-period 1	30,82%	31,50%	35,60%	16,87%
Sub-period 2	41,30%	25,40%	38,20%	25,14%
Sub-period 3	33,40%	20,80%	30,68%	24,0%

From the numbers above, it is clear that AP4 has significantly lower external management fees compared to all the other funds, while they still have a great part of their portfolio under external management. Attempting to investigate this, AP4 recognizes their external management fees for unlisted assets according to two different principles, and is dependent on whether the underlying management agreements permit repayment prior to profit sharing in connection with future profitable exits or not (AP4, 2016).

In practice, this means that the fees depend on what is managed external. If they have external managers that manage their passive index-funds, then the fees are in

general small, often just one or two basis points. However, if they have active external managers, the composition of their compensation package can either be more performance-based, or fixed-fee based. We see that the lower fees of AP4 are during and after the financial crisis, which might indicate that the managers have more heavily incentive-based compensation contracts and have underperformed during this period, and therefore have collected lower fees for several years, and received more when they have recovered the profit.

Looking at the numbers of the other 3 funds, we see that AP2 has the highest fees while also having less of their portfolio managed by external managers than AP1 and AP3. In contrast to AP4, this may indicate either that AP3 have more fixed-fee based contracts and still pay high amounts regardless of performance, or that they have better external managers with more performance-based contracts.

6. Discussion

In this section we will summarize and evaluate both funds' investment management and performance. The purpose of this section is to review the institutional framework in relation to the performance in order to produce a comprehensive comparison.

One of the greatest differences between the funds is the fund structure, as the AP funds have a multi-fund structure and the GPFG have a single-fund structure. Whilst the overarching mandates of the funds are similar, the interpretation differ, as the AP funds are allowed through their governance structure to interpret the mandate as they wish, within the strict investment rules prescribed by statute. In addition, the differences in the underlying purposes of the funds make their liability structures and objectives differ. Contrary to the AP funds, the GPFG, which is categorized as a SWF, has no formal pension liabilities. The GPFG receives oil-revenues and government profits to invest for future generations, and the state is allowed to spend 4%, 3% from February 2017, of the fund's wealth annually in the state budget. This means that if the fund's real return annually is less than 4%, the wealth of the fund will be reduced. In contrast, the AP funds as a SPRF are expected to cover the deficits that arises by the returns generated into Sweden's national pension system, as the actively working population is exceeded by the pensioners receiving pension benefits. Thus, the AP funds receive pension

contributions from the working population, and use these to generate returns, and thus pay out pension liabilities to current pensioners if there is a deficit.

With the different sources of funding and liability structures, in the framework of their mandates and restrictions, their objectives created from the overarching mandates has also differed. The AP funds has throughout the sample period had targets of higher real return, higher active return and higher upper bounds on risk limits than the GPFG. As the AP funds have an obligation to cover the deficits, and have done so every year since 2009, we see that the deficits are normally close to 1-2% of their wealth, meaning they normally pay out less than the GPFG's 4%. As they have less obligations to cover, they might take on more volatility in their investments in an attempt to gain higher returns, within the risk restrictions that they have.

When we compared the returns of funds, we discovered a pattern of the AP funds outperforming the GPFG in the two first sub-periods, while the GPFG considerably increased their returns in the 3rd sub-period and performed better than the AP funds. Although the aggregated AP fund achieves the highest returns, the volatility of these returns are higher than that of the GPFG. When comparing the funds' volatility in relation to returns, it is evident that the GPFG has performed slightly better on an overall basis, and significantly better during the last five years. The pattern found in returns can also be seen in the Sharpe ratios, where the AP funds performed better in the two first periods and GPFG performed considerably better in the last sub-period. The AP funds' Sharpe ratio indicates that the returns are not high enough to justify the additional volatility, compared to GPFG, in the last five years. Thus, we can see a clear trend of the GPFG delivering strong performance in recent years.

On the other hand, the GPFG is one of the world's largest funds, and have therefore been able to diversify away most of the risk, which the AP funds may not be able to do in such a large degree because of the multi-fund structure, but might had been able to do if they had aggregated into one large fund.

As the aggregated AP fund is a fictitious fund, it is difficult to assess to what extent a multi-fund structure would impact the diversification of the risk,

nonetheless, the results suggested that GPFG outperform the aggregated AP fund in terms of the risk-adjusted returns, although the AP funds have achieved higher nominal returns. This might indicate that the GPFG invests in less volatile instruments, but it could also be that the size of the GPFG allow them to diversify away more risk. If degree of diversification is dependent on a funds' size, the AP funds might benefit from a single-fund structure rather than its current structure.

As state-owned pension funds, all the funds have strategic goals derived from their mandates that they should attempt to reduce their total spending. The AP funds have a total cost ratio which is double the ratio of the GPFG, which makes the GPFG the most cost-efficient fund. This might be an indication of economies of scale. However, it is worth mentioning that the transparency of the costs of the funds have been criticized particularly through the treatment of external management fees and transaction costs which may bias their total cost ratios, and therefore make it difficult to draw a definite conclusion.

Furthermore, a low cost ratio is seen as desirable, but as discussed previously, a more active strategy will also entail more costs than a passive investment strategy. The strategies of GPFG and the AP funds have evolved through the sample period, and they all claim to have moved towards more active management strategies, thus moving more in the direction of the Endowment model. Active management entails more risk than a passive strategy, and the funds have consequently become less risk averse, which is reflected in the fund's standard deviation. The total beta from Regression 1 show that the aggregated AP fund is more volatile than the benchmark and GPFG. The indices used there are supposed to be strictly passive, and both funds are clearly more active than the passive benchmarks. However, trading liquidity for return to the extent that the Yale model does, is probably not appropriate for funds that are supposed to safeguard pension assets and sovereign wealth.

The AP funds consistently achieves higher active returns than GPFG through the whole sample. Thus, the pattern of GPFG achieving higher returns in sub-period 3 was not reflected in its active returns. When we compare the returns of the two benchmarks in sub-period 3, we saw that the returns of the GPFG benchmark are higher than the benchmark returns of the AP funds. The low active returns for

GPFG throughout the whole sample period are further supported by the low tracking errors, which indicates that the GPFG tracks their benchmark closer than the AP funds. Which in turn may justify the slightly higher cost ratio of the AP funds.

Even though the GPFG has a lower tracking error than the AP funds, this does not necessarily indicate that the GPFG has a less active strategy than the AP funds, but that their benchmark strategy was better than the passive strategy of the AP fund's benchmark. Nonetheless, the aggregated AP fund did outperform the GPFG on overall returns, so it is logical that they also outperform the GPFG in achieving active returns. This is further highlighted by the information ratio, which indicates that the AP fund is more consistently outperforming its benchmark.

When examining the performance of the GPFG and AP, it is also important to consider what then funds themselves view as performing well. From their investment strategies, GPFG seem to be more concerned with indexing, and the fact that their investment objectives often entails a target for tracking error, which may suggest that the GPFG values a low tracking error. In contrast, the AP funds put more emphasis on achieving high excess returns over a low tracking error, as their investment objectives normally only comprises a specific active return target.

Both the GPFG and the AP funds have an overarching mandate that states that they are to maximize returns at the lowest possible risk, which is very intangible. OECD best practices (2006) recommend that the fund's objectives should be very clear and that they should be consistent with the retirement income of pension funds. OECD also recommend setting clear maximum limit for different types of exposures, and especially risk. We see from both funds' restrictions that GPFG seem to have more comprehensive investment rules with specific limits for asset allocation and risk (See exhibit 1 in appendix A). This is particularly evident when looking at the AP funds own investment objectives, as they, in the beginning, vary in terms of how much active risk they are permitted to take, and what sort of tracking error and information ratio they should aim to have. In later years, they do not have specific objectives for these risk limits, which the GPFG

has and which Severinson and Stewart (2012) recommends. This may cause the AP funds to take on more risk, but also potentially have consequences when they use external managers.

If the external managers have no clear-cut limit of the risk they should take, they may make investments that are not in line with the investment objectives of the AP funds. The restricted regression also revealed that the AP funds have a larger portion of equity investments than what they state that they do. This can be an indication of more investments in equity-like investments with higher risks. Thus, when the external managers do not have a clear-cut risk limits to deal with, they may make more of these equity-like investments with higher risk levels.

7. Conclusion

In this thesis, we set out to investigate similarities and differences between the Norwegian Government Pension Fund - Global and the Swedish National Pension funds, along two dimensions: institutional structure and investment management on one side, and investment performance on the other, and to see whether there is any causality between the two dimensions. We have compared the institutional framework in which the funds operate, and the investment performance of the funds through previous literature and information reported by the funds.

It is clear that the two funds share some similarities, despite their underlying purpose, liability structure and institutional framework being different. Throughout the sample period, both funds' strategies have moved away from the traditional asset allocations, towards allocations more similar to the Endowment model, as they are investing less in fixed income, and more in equity and alternative assets. Both funds claim that they have embraced more active management strategies in recent years, while our result showed that the shift towards active management has been done to a various degree.

Active management entails taking on more risks and costs in an attempt to achieve higher excess returns. The AP funds have, throughout the sample period, focused more on excess returns and have been allowed to deviate more from their benchmark than GPFG. For a fund seeking higher long-term returns, high excess

return and high tracking error is viewed as superior to low excess returns and low tracking errors (Vanguard, 2009). Considering that high returns help safeguard the wealth for future generations and that the fund's need high returns to cover their liabilities, this may suggest that the AP funds strategy is considered superior to strategy of the GPFG.

However, both funds aim to generate high returns without taking undue risk. From our results, the GPFG has a slightly better risk-return relationship on an overall basis. During the sample period, it is evident that the GPFG has had the best development in terms of risk-return trade-off, achieving a considerably higher Sharpe ratio in the last five years, compared to the AP funds. The standard deviation and the first regression showed that the aggregated AP fund has the riskiest portfolio, and the Sharpe Ratio suggest that the higher returns they achieve does not justify the added risk, in the last sub-period.

Both funds aim to reduce total spending, and throughout the whole sample period GPFG has proven to be the most cost-efficient in operations. However, the GPFG is also the least active fund which can explain why they have a lower total cost ratio compared to the AP. However, the funds have been criticized for having a lack of transparency in relation to their transaction costs and external management fees, which might bias their total cost ratios.

Even though GPFG delivers better Sharpe ratios and is more cost-efficient, the strategy that the AP funds seem to employ is considered superior for funds seeking long-term high returns. However, the institutional framework that the GPFG has operated in may not have allowed it to employ the same strategy as the AP funds. It is therefore not given that the GPFG will perform better than the AP funds in the future, even though the current trend indicates the opposite.

For further research on the topic, it would be interesting to compare the funds to several other pension funds, with different strategies and structures. Both to gain further insights to how different institutional structures can affect performance and to investigate if there exists economies of scale. It would also be interesting to look more in-debt into cost management, and costs related to external management in particular.

8. Bibliography

Akintona, M. (2017). Investment Management Strategy: Yale University Endowment Model 2005-2016. SSRN Electronic Journal. doi:10.2139/ssrn.2895114

Aktiespararna (2010, May 25th). Så förvaltar AP-fonderna dina pensionspengar. Retrieved from: https://www.aktiespararna.se/artiklar/Fonder/Sa-forvaltar-AP-fonderna-dina-pensionspengar

Ang, A. (2010). The Four Benchmarks of Sovereign Wealth Funds. *Columbia Business School and NBER*. Retrieved from: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1680485

Ang, A., Goetzmann, W. N., & Schaefer, S. (2009). Evaluation of Active Management of the Norwegian Government Pension Fund–Global. *Report to the Norwegian Ministry of Finance*. Retrieved from: https://www0.gsb.columbia.edu/faculty/aang/papers/report%20Norway.pdf

Antolin, P. (2008). Pension Fund Performance. *OECD Working Papers on Insurance and Private Pensions,* No.20, OECD Publishing. doi:10.1787/240401404057. Retrieved from: http://www.oecd.org/finance/private-pensions/41218144.pdf

AP1. (2012). History of the AP Funds. *Första AP-Fonden.* Retrieved from: http://www.ap1.se/en/About-AP1/History-of-the-AP-funds/

AP2. (2016a). History of the AP Funds. *Andra AP-Fonden.* Retrieved from: http://www.ap2.se/en/about-ap2/our-mission/a-unique-pension-system/history/

AP2. (2016b). Strategic Portfolio. *Andra AP-Fonden.* Retrieved from: http://www.ap2.se/en/management/asset-management/asset-management-strategy/strategic-portfolio/

AP2. (2017). Investment rules. *Andra AP-Fonden.* Retrieved from: http://www.ap2.se/en/management/asset-management/investment-rules/

AP3. (2015). Annual Report. *Tredje AP-Fonden.* Retrieved from:
http://www.ap3.se/wp-content/uploads/2016/05/Annual-Report-2015.pdf

AP3. (2016). Frequently asked questions. *Tredje AP-Fonden.* Retrieved from:
http://www.ap3.se/en/aktuellt/vanliga-fragor-och-svar/

AP4. (2014). Our History. *Fjärde AP-Fonden.* Retrieved from:
http://www.ap4.se/en/about-ap4/the-ap-funds---a-part-of-the-pension-system/our-history/

AP4. (2016). Annual Report 2016. *Fjärde AP-Fonden.* Retrieved from:
http://www.ap4.se/globalassets/dokument/rapportarkiv/2016/ar16/eng/annual-report-2016.pdf

BIS. (2012). The Sustainability of Pension Schemes. *Bank for International Settlements Working Paper, No. 368* Retrieved from:
https://www.bis.org/publ/work368.htm

Blommestein, H. J., & Funke, N. (1998). Institutional Investors in the New Financial Landscape. *Directorate For Financial and Enterprise Affairs.* OECD Publising, Retrieved from: http://www.oecd-ilibrary.org/finance-and-investment/institutional-investors-in-the-new-financial-landscape_9789264163065-en

Blomstergren, S., and Lindgren, J. (2008). Active Management In Swedish National Pension Funds: An Analysis of Performance in the AP-Funds. Retrieved from: https://slidex.tips/download/active-management-in-swedish-national-pension-funds#

Blundell-Wignall, A., Hu, Y.-W., & Yermo, J. (2008). Sovereign Wealth and Pension Fund Issues. *OECD Working Papers on Insurance and Private Pensions, 14*.

Brooks, C. (2008). Introductory Econometrics for Finance. Cambridge University Press.

Bugar, G., & Maurer, R. (2002). International Equity Portfolios and Currency Hedging: The Viewpoint of German and Hungarian Investors. *ASTIN Bulletin: The Journal of the IAA*, *32(1*), 171-197. Retrieved from: https://www.casact.org/library/astin/vol32no1/171.pdf

CEM (2018). About us. *CEM Benchmarking.* Retrieved from: http://www.cembenchmarking.com/aboutus/aboutus.aspx

Chambers, D., Dimson, E., & Ilmanen, A. (2012). The Norway Model. *The Journal of Portfolio Management, 38*(2), 67-81.

Clark, G. L., & Monk, A. H. (2010). The Norwegian government pension fund: Ethics Over Efficiency. *Rotman International Journal of Pension Management, 3*(1).

Curtis, G. (2012). Yale Versus Norway. *Graycourt: White Paper No. 55*. Retrieved from https://www.greycourt.com/wp-content/uploads/2012/09/WhitePaperNo55-YaleVersusNorway.pdf

Ferri, R. (2012, April 16th). The Curse of the Yale Model. *Forbes*. Retrieved from https://www.forbes.com/sites/rickferri/2012/04/16/the-curse-of-the-yale-model/#10a271053dae

Folpmers, Marco. (2012). The Defined Benefit Occupational System. *Capgemini Consulting*. Retrieved from https://www.capgemini.com/nl-nl/wp-content/uploads/sites/7/2017/07/The_defined_benefit_occupational_pension_system_1.pdf

Fixen, R. (2016, March 29th). Report finds lack of cost transparency at Sweden´s AP Funds. *Intelligence on European Pensions and Institutional Investment.* Retrieved from https://www.ipe.com/countries/nordic-region/report-finds-lack-of-cost-transparency-at-swedens-ap-funds/www.ipe.com/countries/nordic-region/report-finds-lack-of-cost-transparency-at-swedens-ap-funds/10012504.fullarticle

Grinold R. and R. Kahn. (1999). *Active Portfolio Management: A Quantitative Approach for Providing Superior Returns and Controlling Ris*k. McGraw-Hill Professional.

Hoepner, A. G. F., & Schopohl, L. (2016). On the Price of Morals in Markets: An Empirical Study of the Swedish AP Funds and the Norwegian Government Pension Fund. *Journal of Business Ethics*, 1-28. doi:10.1007/s10551-016-3261-0

Lee, S. (1999). Style Analysis and Property Performance. *Journal of Property Fund Performance, 17(2*), 145-157. doi: 10.1108/14635789910258534

Mason, C. H., & Perreault, Jr, W. D. (1991). Collinearity, Power, and Interpretation of Multiple Regression Analysis. *Journal of Marketing Research, 28*(3), 268-280. doi:10.2307/3172863

Moss, G. (2017, June). Sweden: AP Funds Power On. *Intelligence on European Pensions and Institutional Investment*. Retrieved from: https://www.ipe.com/pensions/country-reports/nordic-region/sweden-ap-funds-power-on/10019215.article

NBIM. (2012). The Use of Benchmarks in the Fund Management. *Norges Bank Investment Management.* Retrieved from https://www.nbim.no/en/transparency/features/2012/use-of-benchmarks-in-the-fund-management/

NBIM. (2016a). About the Fund. *Norges Bank Investment Management.* Retrieved from https://www.nbim.no/en/the-fund/about-the-fund

NBIM. (2016b). Performance Results 2016 GIPS. *Norges Bank Investment Management.* Retrieved from https://www.nbim.no/en/the-fund/return-on-the-fund/methodology-for-the-calculation-of-returns/

NBIM. (2017a). Management Mandate. *Norges Bank Investment Management* Retrieved from: https://www.nbim.no/en/the-fund/governance-model/management-mandate/

NBIM. (2017b). Presentation of investment performance in compliance with the Global Investment Performance Standards Manual. *Norges Bank Investment Management*. Retrieved from: https://www.nbim.no/contentassets/9d31252607434303a4e6a590fa6da110/norges -bank-investment-management-gips-manual-2016.pdf

NBIM. (2017c). The History. *Norges Bank Investment Management*. Retrieved from https://www.nbim.no/en/the-fund/the-history/

NBIM. (2017d). Returns. *Norges Bank Investment Management*. Retrieved from https://www.nbim.no/en/the-fund/return-on-the-fund/

NBIM. (2017e). Investment Mandate – Government Pension Fund Global. *Norges Bank Investment Management*. Retrieved from: https://www.nbim.no/contentassets/43615da4359c4a47a60ee55e03511589/nbim-ceo-investment-mandate.pdf

NBIM. (2017f). Review of Norges Bank's Management of the Government Pension Fund Global. *Letter to the Ministry of Finance, 15 December 2017*. Retrieved from: https://www.nbim.no/en/transparency/submissions-to-ministry/2017/review-of-norges-banks-management-of-the-government-pension-fund-global/

NBIM. (2018d). Transparency. *Norges Bank Investment Management*. Retrieved from https://www.nbim.no/en/transparency/

Norges Bank. (2018b) Short Term Interest Rates. *Norges Bank Investment Management*. Retrieved from: https://www.norges-bank.no/en/Statistics/Historical-monetary-statistics/Short-term-interest-rates/

NBIM. (2018c). External Mandates. *Norges Bank Investment Management*. Retrieved from: https://www.nbim.no/en/investments/external-mandates/ https://www.nbim.no/en/transparency/submissions-to-ministry/2017/review-of-norges-banks-management-of-the-government-pension-fund-global/

OECD (2006). OECD Guidelines for Pension Fund Asset Management: Recommendation of the Council. *Directorate For Financial and Enterprise Affairs.* Retrieved from: http://www.oecd.org/finance/private-pensions/36316399.pdf

OECD. (2015). Pensions at a Glance 2015: OECD and G20 Indicators. *Directorate For Financial and Enterprise Affairs.* OECD Publishing, Paris. Retrieved from: http://dx.doi.org/10.1787/pension_glance-2015-en

Oslo Børs. (2018). NIBOR 6 Month. Retrieved from: https://www.oslobors.no/markedsaktivitet/#/details/NIBOR6M.NIBOR/overview

Ponds, E., C. Severinson, C., and Yermo, J. (2011). Funding in Public Sector Pension Plans - International Evidence. *National Bureau of Economic Research.* OECD Publishing. Retrieved from: http://dx.doi.org/10.1787/5kgcfnm8rgmp-en

Riksbanken. (2018). Interest Rates and Exchange Rates. Retrieved from https://www.riksbank.se/en-gb/statistics/search-interest--exchange-rates/?g5-SEDP6MSTIBOR=on&from=01%2F03%2F2000&to=05%2F06%2F2018&f=Month&c=cAverage&s=Comma

Riksdagen. (2014, December 12). Lag (2000:192) om allmänna pensionsfonder (AP-fonder). *Svensk författningssamling 2000:2000:192 t.o.m. SFS 2014:979 - Riksdagen.* Retrieved from: https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/lag-2000192-om-allmanna-pensionsfonder_sfs-2000-192

Rundell, S. (2017, November 2nd). AP1 to Up Leverage, Factor Exposure. *Top 1000 Funds: Investment Strategies for the World's Largest Institutional Investors.* Retrieved from: https://www.top1000funds.com/profile/2017/11/02/ap1-to-up-leverage-factor-exposure/

Severinson, C., & Stewart, F. (2012). Review of the Swedish National Pension Funds. *OECD Working Papers on Finance, Insurance and Private Pensions, 17*. Retrieved from: http://dx.doi.org/10.1787/5k990qtkk6f8-en

Statistik Databasen. (2018). Swedish Consumer Price Index. Retrieved from: http://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__PR__PR0101__PR0101A/KPISkuggM/table/tableViewLayout1/?rxid=894c9bbe-136c-4623-8d7c-bfda7d66d415

Tapia, W. (2008). Comparing Aggregate Investment Returns in Privately Managed Pension Funds: An Initial Assessmen*t. OECD Working Papers on Insurance and Private Pensions, No. 21,* OECD publishing, © OECD. doi:10.1787/237833258822

Vittas, D., Impavido, G. and O´Connor, R. (2008). Upgrading the Investment Policy Framework Of Public Pension Funds. *Policy Research Working Paper 4499*. Retrieved from: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1089270

Vanguard (2009). Understanding Excess Return and Tracking Error. *The Vanguard Group, Inc.* Retrieved from: *https://www.vanguard.com/jumppage/international/web/pdfs/INTUTE.pdf*

Willis Tower Watson. (2017). Pensions & Investments - Willis Tower Watson 300 Analysis. Retrieved from: https://www.willistowerswatson.com/-/media/WTW/PDF/Insights/2017/09/The-worlds-300-largest-pension-funds-year-ended-2016.pdf

Yermo, J. (2008). Governance and Investment of Public Reserve Funds in Selected OECD Countries. *OECD Working Paper on Insurance and Private Pentions 15* (Paris: Organization for Economic Co-operation and Development, 2008). Retrieved from: https://www.oecd.org/finance/financial-markets/40196093.pdf

9. Appendices

Appendix A: Investment Directives, Asset Allocation and Mandates

Exhibit 1: Investment Directives NBIM

1. The equity portfolio shall constitute between 50-80% of the investment portfolio.
2. The bond portfolio shall constitute between 20-50% of the investment portfolio.
3. The unlisted real estate portfolio may constitute up to 7% of the investment portfolio.
4. Net market value shall be used to calculated the respective shares, and in such calculations, derivatives shall be depicted with the underlying economic exposure.
5. The Bank shall organize the management with the aim that the expected annualized standard deviation for the relative return between the investment portfolio and the actual benchmark index (expected tracking error) does not exceeds 1.25%.
6. The equity and bond portfolios shall be composed in such a way that the expected relative return is exposed to several systematic risk factors.
7. The Bank shall seek to take account of differences in fiscal strength between countries in the composition of government bond investments.
8. The Bank shall organize the management with the aim that high-yield bonds (credit rating lower than investment grade) do not exceed 5 per cent of the market value of the bond portfolio.
9. A credit rating is required for investments in debt instruments. All internal credit rating assessments shall be documented.
10. The equity portfolio may not be invested in more than 10 per cent of the voting shares in an individual company. Ownership in listed and unlisted real estate companies is exempt from this rule.
11. The unlisted real estate portfolio shall be well diversified geographically, across sectors and individual properties.
12. Leverage may be used with a view to performing the management assignment in an effective manner, but not with a view to increasing the investment portfolio's exposure to risky assets in the equity and bond portfolios. Leverage may also be used in fund structures and by other legal entities with the aim of performing the management assignment in an effective manner, but such leverage may not be with a view to increasing the investment portfolio's exposure to risky assets.
13. Reinvestment of cash collateral shall not take place with a view to increasing the investment portfolio's financial exposure to risky assets.
14. Short selling is only permitted if the Bank has access to the securities through an established borrowing arrangement.

Exhibit 2: Investment Directives AP

---

v Investments may be made in all types of listed and negotiable instruments on the capital market

v At least 30 percent invested in fixed income securities with low credit and liquidity risk

v Maximum of 40 percent exposure to currency risk

v Maximum of 5 percent invested in unlisted securities and only indirectly via mutual funds or venture capital companies

v Maximum of 10 percent of the voting rights invested in single listed company. For unlisted venture capital companies, a maximum of 30 percent

v Shares listed in Swedish companies: maximum of 2 percent of the total value of Swedish shares on an authorized Swedish stock exchange or marketplace

v At least 10 percent managed by external managers

v No commodities

Source: AP1 (2008)

Exhibit 3: Overview of the Reference Portfolio's Asset Allocation

This table represent the asset allocation of the respective funds reference portfolios to highlight the changes through the entire sample periods. The first part looks at the initial strategy in 2002, the next shows the strategy for the second sub-period before the financial crisis, the third part shows the changes in the aftermath of the financial crisis, and the last part if the current strategy.

	GPFG	AP1	AP2	AP3	AP4
Initial strategy (2002)	**Equity: 40%** **Fixed-inc: 60%**	**Equity: 57%** Sweden: 12% Foreign: 40% Emerging: 5% **Fixed-inc: 40%** Foreign: 32% Index.l: 8% **Alt.inv: 3%**	**Equity: 60%** Swedish: 20% Foreign: 40% Emerging: 6% **Fixed-inc: 37%** Swedish: 21% Foreign: 16% **Real est: 3%**	**Equity: 54.5%** Sweden: 16% Foreign: 38.5% **Fixed-inc: 37.5%** Sweden: 13.5% Foreign:16.5% Index-l: 7.5% **Real est: 8%**	**Equity: 63,5%** Swedish: 22.5% Foreign: 40% **Fixed-inc: 37.5%**
Before financial crisis (2007)	**Equity: 60%** **Fixed-inc: 40%**	**Equity: 59%** Sweden: 13% Foreign: 40% Emerging: 6% **Fixed-inc: 39%** Swedish: 9% Foreign: 21% Index.l:9% **Alt.Inv: 3%**	**Equity: 60%** Swedish: 20% Foreign: 40% **Fixed-inc:36%** **Alt.inv: 4%**	**Equity: 54,5%** **Fixed-inc: 37%** **Real est: 8,5%**	**Equity: 63,3%** Swedish: 19% Foreign: 41% Global: 38% Emerging: 3% **Fixed-inc: 36.9%** **Alt.inv: 3,2%**
After financial crisis (2010)	**Equity: 50-70%** **Fixed 30-50%** **Real est: 0-5%**	**Equity: 59%** Sweden: 16% Foreign: 32% Emerging: 10% **Fixed.inc: 32%** Swedish: 12% Foreign: 12% Index-l: 8% **Alt.inv: 8%**	**Equity: 52%** Swedish: 18% Foreign: 29% Emerging: 5% **Fixed-inc: 37%** Government: 30% Credit: 7% **Alt.inv: 11%** Real est: 5%	N/A	**Equity: 61,6%** **Fixed-inc: 34.5%** **Real est: 3.9%**
Current strategy (2017)	**Equity: 70%** **Fixed-inc: 30%**	Equity: 43.5% Fixed-inc: 30% Alt.inv: 26.5%	**Equity: 42.5%** Swedish: 9.5% Developed: 22% Emerging: 11% **Fixed-inc: 33.5%** Emerging: 6% **Alt.inv: 24%** Real est: 11%	N/A	N/A

Exhibit 4: Overview of the Interpretation of Mandates

This table represent the investment performance objectives on the targets the respective funds have in terms of return and risk. The changes in objectives reflects the changes in mandates, and thus how these have changed throughout the entire sample period. The first part looks at the initial strategy in 2002, the next shows the strategy for the second sub-period before the financial crisis, the third part shows the changes in the aftermath of the financial crisis, and the last part if the current strategy.

	GPFG	AP1	AP2	AP3	AP4
Initial strategy (2002)	Real Return: 4% IR: 0.2 - 0.3	Active Return: 0.5% Min. IR: 0.3 TE: 3%	Active Return: 0.5% Active risk: 2%	Active Return: 0,4% Active Risk:5% Max IR: 0.2	Active Return: 15% Active Risk: 4% Max IR: 0.2
Before financial crisis (2007)	Real Return: 4% Active Return: 0.25% Max TE: 1.5%	Real Return: 5.1%-6.1% Active Return: 0.5% Min IR: 0.3 TE: 3%	Real Return: 4.5% Active Return: 0,5%	Real Return: 4% Active Return: 0.6%	Real Return: 4.5% Active Return: 0.4%
After financial crisis (2010)	Max TE: 1.5% Max 4% spending of revenue	Real Return: 5.5%	Real Return: 5%	Real Return: 4%	Real Return: 4.5% Active Return: 0.5%
Current strategy (2017)	Max TE: 1.25%	Real Return: 4%	Real Return: 4.5%	Real Return: 4%	Real Return (long-term): 4% Real Return (short-term): 3%

Appendix B: Robustness Test and Correlation Matrix

Exhibit 5: Summary of robustness test: end of period vs beginning of period exchange rates

	Returns	
	End	Beginning
overall	4,93 %	4,62 %
sub 1	8,42 %	8,17 %
sub 2	2,77 %	1,17 %
sub 3	2,91 %	3,81 %

Exhibit 6: Correlation Matrix

	H MSCI	H BB	MSCI	BB
H MSCI	1			
H BB	0,778496	1		
MSCI	0,908983	0,465024	1	
BB	0,444057	0,835294	0,139657	1

Appendix C: Summary Statistics from Regressions

Exhibit 7: Summary Statistics: Regression 1, Unrestricted

		GPFG	Agg AP	AP 1	AP 2	AP 3	AP 4
		Unrestricted Regression (Performance Analysis)					
cst	α	0,0091	0,0141	0,0130	0,0140	0,0143	0,0153
equity	β_0	0,6459	0,8322	0,8228	0,8706	0,7886	0,8472
fixed	β_1	0,5694	0,8474	0,9253	0,8766	0,8174	0,7719
	SSR	0,0127	0,0400	0,0398	0,0421	0,0468	0,0357
	s^2	0,0004	0,0014	0,0014	0,0015	0,0016	0,0012
	s	0,0210	0,0371	0,0371	0,0381	0,0402	0,0351
se:	α	0,0038	0,0067	0,0067	0,0068	0,0072	0,0063
	β_0	0,0317	0,0562	0,0560	0,0576	0,0607	0,0531
	β_1	0,0897	0,1589	0,1585	0,1629	0,1718	0,1502
t-stat	α	2,4215	2,1177	1,9584	2,0403	1,9838	2,4217
	β_0	20,3770	14,8148	14,6852	15,1149	12,9847	15,9558
	β_1	6,3509	5,3335	5,8386	5,3811	4,7585	5,1400
	R^2	0,9479	0,9092	0,9105	0,9122	0,8856	0,9183
Appr rat	semi	0,4354	0,3808	0,3521	0,3669	0,3567	0,4354
	annual	0,6158	0,5385	0,4980	0,5188	0,5045	0,6158
	sum beta	1,2153	1,6797	1,7481	1,7472	1,6060	1,6190

Exhibit 8: Summary Statistics: Regression 1, Restricted

		GPFG	Agg AP	AP 1	AP 2	AP 3	AP 4
		Restricted Regression (Style Analysis)					
cst	α	0,0107	0,0192	0,0186	0,0195	0,0188	0,0199
equity	β_0	0,6339	0,7942	0,7810	0,8288	0,7547	0,8125
fixed	β_1	0,3661	0,2058	0,2190	0,1712	0,2453	0,1875
	SSR	0,0153	0,0656	0,0709	0,0730	0,0671	0,0570
	s^2	0,0005	0,0023	0,0024	0,0025	0,0023	0,0020
	s	0,0230	0,0476	0,0494	0,0502	0,0481	0,0443
se:	α	0,0041	0,0086	0,0089	0,0090	0,0087	0,0080
	β_0	0,0348	0,0719	0,0748	0,0759	0,0728	0,0670
	β_1	0,0983	0,2035	0,2114	0,2147	0,2058	0,1896
t-stat	α	2,5967	2,2449	2,0945	2,1649	2,1772	2,4958
	β_0	18,2402	11,0382	10,4470	10,9197	10,3710	12,1182
	β_1	3,7249	1,0114	1,0360	0,7977	1,1918	0,9887
	R^2	0,9373	0,8511	0,8408	0,8476	0,8357	0,8698
Appr rat	semi	0,4669	0,4037	0,3766	0,3893	0,3915	0,4488
	annual	0,6603	0,5709	0,5326	0,5505	0,5536	0,6347
	sum beta	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000

Exhibit 9: Summary Statistics: Regression 2, Unrestricted

			Agg AP	AP 1	AP 2	AP 3	AP 4
			Unrestricted Regression (Performance Analysis)				
	cst	α	0,0110	0,0103	0,0107	0,0114	0,0116
unhedged	equity	β_0	0,6194	0,6980	0,6295	0,6576	0,4845
	fixed	β_1	-0,4578	-0,4309	-0,4068	-0,6654	-0,3160
hedged	equity	β_2	0,0161	-0,0698	0,0444	-0,0812	0,1799
	fixed	β_3	0,5517	0,6230	0,5261	0,6840	0,3642
		SSR	0,0042	0,0044	0,0064	0,0046	0,0052
		s^2	0,0002	0,0002	0,0002	0,0002	0,0002
		s	0,0125	0,0128	0,0154	0,0131	0,0139
	se:	α	0,0024	0,0024	0,0029	0,0025	0,0026
		β_0	0,1425	0,1452	0,1752	0,1491	0,1583
		β_1	0,1394	0,1421	0,1715	0,1459	0,1549
		β_2	0,1391	0,1418	0,1711	0,1455	0,1545
		β_3	0,1263	0,1288	0,1554	0,1322	0,1404
	t-stat	α	4,6838	4,3125	3,7050	4,6306	4,4527
		β_0	4,3472	4,8053	3,5920	4,4104	3,0613
		β_1	-3,2832	-3,0313	-2,3721	-4,5601	-2,0399
		β_2	0,1159	-0,4922	0,2598	-0,5581	1,1642
		β_3	4,3668	4,8370	3,3853	5,1735	2,5944
		R^2	0,9904	0,9901	0,9866	0,9886	0,9880
	Appr rat	semi	0,8801	0,8103	0,6962	0,8701	0,8367
		annual	1,2446	1,1460	0,9845	1,2305	1,1832
		sum beta	0,7294	0,8203	0,7932	0,5950	0,7126

Exhibit 10: Summary Statistics: Regression 2, Restricted

			Agg AP	AP 1	AP 2	AP 3	AP 4
			Restricted Regression (Style Analysis)				
	cst	α	0,0102	0,0092	0,0098	0,0103	0,0115
unhedged	equity	β_0	0,5252	0,5038	0,4984	0,5372	0,5612
	fixed	β_1	0,0000	0,0000	0,0000	0,0000	0,0000
hedged	equity	β_2	0,1476	0,1495	0,2041	0,0949	0,1424
	fixed	β_3	0,3272	0,3467	0,2974	0,3679	0,2964
		SSR	0,0064	0,0060	0,0080	0,0094	0,0071
		s^2	0,0002	0,0002	0,0002	0,0003	0,0002
		s	0,0155	0,01368	0,01578	0,01718	0,01486
	se:	α	0,0029	0,0026	0,0030	0,0032	0,0028
		β_0	0,1758	0,1556	0,1794	0,1953	0,1690
		β_1	0,1720	0,1523	0,1756	0,1912	0,1654
		β_2	0,1716	0,1519	0,1751	0,1907	0,1649
		β_3	0,1559	0,1380	0,1591	0,1732	0,1499
	t-stat	α	3,5149	3,5928	3,3211	3,1822	4,1332
		β_0	2,9881	3,2380	2,7779	2,7502	3,3211
		β_1	0,0000	0,0000	0,0000	0,0000	0,0000
		β_2	0,8603	0,9845	1,1655	0,4976	0,8631
		β_3	2,0996	2,5132	1,8694	2,1239	1,9781
		R^2	0,9854	0,9865	0,9834	0,9769	0,9839
	Appr rat	semi	0,6604	0,6751	0,6240	0,5979	0,7766
		annual	0,9340	0,95471	0,88253	0,84561	1,09832
		sum beta	1,0000	1,0000	1,0000	1,0000	1,0000

Appendix D: Summary of Returns, Active Returns and Costs

Exhibit 11: Summary of Semi-Annual Returns (USD)

	Semi-annual returns (USD)					
	GPFG	Agg AP	AP 1	AP2	AP 3	AP 4
2017	8,77 %	6,92 %	7,32 %	7,18 %	6,34 %	6,85 %
2017	10,40 %	13,30 %	13,36 %	12,92 %	13,57 %	13,35 %
2016	2,61 %	-0,19 %	-1,53 %	-0,63 %	0,62 %	0,75 %
2016	2,36 %	2,13 %	3,20 %	3,09 %	0,94 %	1,37 %
2015	-4,17 %	-1,75 %	-2,48 %	-2,57 %	-1,14 %	-0,85 %
2015	1,92 %	-0,24 %	-0,82 %	-0,75 %	0,45 %	0,15 %
2014	-4,98 %	-8,61 %	-8,18 %	-9,58 %	-8,78 %	-7,89 %
2014	5,75 %	2,63 %	2,47 %	2,72 %	2,29 %	3,04 %
2013	12,46 %	13,70 %	12,27 %	13,70 %	13,81 %	15,02 %
2013	2,07 %	1,21 %	0,36 %	0,46 %	1,61 %	2,47 %
2012	10,11 %	12,70 %	13,13 %	13,80 %	12,29 %	11,57 %
2012	3,94 %	4,50 %	3,90 %	5,05 %	3,95 %	5,12 %
2011	-9,70 %	-11,12 %	-10,91 %	-11,84 %	-11,58 %	-10,12 %
2011	6,36 %	8,46 %	8,08 %	9,09 %	8,27 %	8,40 %
2010	18,17 %	25,94 %	26,22 %	27,00 %	23,76 %	26,86 %
2010	-7,91 %	-6,89 %	-7,13 %	-7,03 %	-6,38 %	-7,06 %
2009	19,24 %	21,90 %	22,41 %	22,85 %	20,15 %	22,27 %
2009	9,67 %	8,72 %	9,00 %	8,59 %	7,42 %	10,01 %
2008	-24,71 %	-34,89 %	-35,34 %	-36,40 %	-33,71 %	-34,04 %
2008	-3,87 %	-1,62 %	-1,13 %	-2,37 %	-1,05 %	-1,92 %
2007	4,79 %	3,60 %	4,53 %	3,27 %	4,36 %	2,20 %
2007	5,16 %	6,48 %	6,18 %	6,80 %	6,70 %	6,20 %
2006	9,16 %	15,21 %	15,39 %	16,69 %	13,46 %	15,33 %
2006	5,50 %	11,83 %	10,69 %	12,60 %	12,55 %	11,43 %
2005	3,81 %	6,64 %	6,49 %	7,50 %	6,53 %	6,03 %
2005	-1,52 %	-7,68 %	-7,74 %	-7,73 %	-7,46 %	-7,81 %
2004	12,83 %	19,51 %	19,71 %	20,09 %	19,33 %	18,88 %
2004	1,18 %	0,92 %	0,87 %	0,81 %	1,13 %	0,87 %
2003	12,90 %	21,78 %	21,45 %	22,37 %	21,34 %	22,00 %
2003	10,65 %	16,39 %	16,44 %	16,54 %	16,30 %	16,30 %
2002	0,76 %	-1,29 %	-0,86 %	-1,34 %	-0,57 %	-2,42 %
2002	3,97 %	7,68 %	8,42 %	6,76 %	9,45 %	6,12 %

Exhibit 12: Summary of Semi – Annual Active Returns (USD)

	GPFG	Agg AP	AP 1	AP 2	AP 3	AP 4
		Relative return (USD)				
2017		0,41 %	0,81 %	0,67 %	-0,17 %	0,34 %
2017		1,57 %	1,63 %	1,19 %	1,84 %	1,62 %
2016	0,44 %	1,84 %	0,49 %	1,40 %	2,64 %	2,77 %
2016	-0,30 %	0,86 %	1,92 %	1,82 %	-0,33 %	0,09 %
2015	-0,12 %	2,61 %	1,88 %	1,79 %	3,22 %	3,51 %
2015	0,58 %	2,50 %	1,92 %	2,00 %	3,19 %	2,89 %
2014	-0,58 %	1,49 %	1,92 %	0,52 %	1,32 %	2,21 %
2014	-0,11 %	0,34 %	0,18 %	0,43 %	0,00 %	0,75 %
2013	0,27 %	0,06 %	-1,38 %	0,06 %	0,16 %	1,38 %
2013	0,63 %	1,71 %	0,85 %	0,95 %	2,10 %	2,96 %
2012	0,12 %	1,41 %	1,84 %	2,51 %	0,99 %	0,28 %
2012	0,08 %	1,19 %	0,58 %	1,73 %	0,63 %	1,81 %
2011	-0,28 %	-0,35 %	-0,13 %	-1,06 %	-0,80 %	0,65 %
2011	0,18 %	1,62 %	1,24 %	2,25 %	1,43 %	1,55 %
2010	0,71 %	0,16 %	0,44 %	1,22 %	-2,01 %	1,08 %
2010	0,33 %	1,59 %	1,36 %	1,46 %	2,10 %	1,43 %
2009	2,16 %	0,65 %	1,16 %	1,59 %	-1,10 %	1,01 %
2009	1,65 %	-0,55 %	-0,28 %	-0,68 %	-1,85 %	0,74 %
2008	-2,82 %	-4,08 %	-4,53 %	-5,59 %	-2,90 %	-3,23 %
2008	-0,61 %	2,18 %	2,67 %	1,43 %	2,75 %	1,88 %
2007	-0,66 %	-0,40 %	0,53 %	-0,73 %	0,36 %	-1,80 %
2007	0,42 %	2,05 %	1,75 %	2,37 %	2,27 %	1,77 %
2006	0,05 %	1,99 %	2,17 %	3,47 %	0,24 %	2,11 %
2006	0,09 %	3,21 %	2,07 %	3,98 %	3,93 %	2,81 %
2005	0,68 %	1,73 %	1,58 %	2,58 %	1,62 %	1,12 %
2005	0,30 %	0,92 %	0,86 %	0,87 %	1,14 %	0,79 %
2004	0,23 %	0,19 %	0,40 %	0,78 %	0,02 %	-0,43 %
2004	0,30 %	-0,06 %	-0,11 %	-0,17 %	0,15 %	-0,10 %
2003	0,25 %	-1,27 %	-1,61 %	-0,69 %	-1,72 %	-1,06 %
2003	0,30 %	1,05 %	1,09 %	1,19 %	0,95 %	0,95 %
2002	-0,05 %	0,69 %	1,12 %	0,64 %	1,41 %	-0,43 %
2002	0,37 %	3,38 %	4,11 %	2,45 %	5,15 %	1,82 %

Exhibit 13: Summary of Semi – Annual Cost Ratio

	Semi-annual cost ratio					
	GPFG	Agg AP	AP 1	AP2	AP 3	AP 4
2017	0,03 %	0,06 %	0,06 %	0,08 %	0,05 %	0,05 %
2017	0,03 %	0,06 %	0,08 %	0,07 %	0,06 %	0,05 %
2016	0,03 %	0,06 %	0,06 %	0,08 %	0,06 %	0,05 %
2016	0,02 %	0,07 %	0,07 %	0,08 %	0,06 %	0,05 %
2015	0,03 %	0,07 %	0,08 %	0,09 %	0,06 %	0,05 %
2015	0,03 %	0,07 %	0,09 %	0,09 %	0,06 %	0,06 %
2014	0,03 %	0,08 %	0,09 %	0,09 %	0,06 %	0,05 %
2014	0,03 %	0,07 %	0,08 %	0,09 %	0,07 %	0,06 %
2013	0,03 %	0,07 %	0,08 %	0,09 %	0,07 %	0,06 %
2013	0,04 %	0,07 %	0,07 %	0,08 %	0,07 %	0,06 %
2012	0,03 %	0,07 %	0,07 %	0,08 %	0,07 %	0,05 %
2012	0,03 %	0,07 %	0,08 %	0,09 %	0,06 %	0,05 %
2011	0,04 %	0,06 %	0,06 %	0,08 %	0,05 %	0,04 %
2011	0,04 %	0,06 %	0,06 %	0,08 %	0,06 %	0,05 %
2010	0,06 %	0,07 %	0,06 %	0,09 %	0,06 %	0,05 %
2010	0,05 %	0,07 %	0,07 %	0,09 %	0,08 %	0,05 %
2009	0,07 %	0,08 %	0,08 %	0,09 %	0,09 %	0,06 %
2009	0,07 %	0,08 %	0,09 %	0,09 %	0,08 %	0,06 %
2008	0,06 %	0,07 %	0,08 %	0,08 %	0,07 %	0,05 %
2008	0,05 %	0,07 %	0,07 %	0,07 %	0,06 %	0,05 %
2007	0,05 %	0,06 %	0,07 %	0,06 %	0,06 %	0,05 %
2007	0,05 %	0,07 %	0,08 %	0,07 %	0,07 %	0,05 %
2006	0,05 %	0,07 %	0,08 %	0,07 %	0,07 %	0,06 %
2006	0,05 %	0,07 %	0,07 %	0,08 %	0,08 %	0,06 %
2005	0,06 %	0,06 %	0,08 %	0,07 %	0,04 %	0,06 %
2005	0,05 %	0,10 %	0,09 %	0,10 %	0,13 %	0,08 %
2004	0,06 %	0,12 %	0,17 %	0,10 %	0,13 %	0,08 %
2004	0,05 %	0,09 %	0,08 %	0,11 %	0,08 %	0,10 %
2003	0,06 %	0,10 %	0,08 %	0,11 %	0,11 %	0,10 %
2003	0,05 %	0,08 %	0,07 %	0,08 %	0,08 %	0,09 %
2002	0,05 %	0,08 %	0,07 %	0,08 %	0,08 %	0,06 %
2002	0,04 %	0,06 %	0,06 %	0,07 %	0,05 %	0,07 %